ARMY RESEARCH AND DEVELOPMENT

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375 Vie, 96 Selected to Give Army Science Conference Papers

Based on evaluation of narrative summaries of proposed technical papers submitted by 375 aspirants seeking to report on Army in-house laboratory research at the 1964 biennial Army Science Conference, 96 have been selected for presentation. The conference is set June 16-19.

The United States Military Academy at West Point, N.Y., which has entertained the meeting since they were initiated in 1957 (the 1961 conference was deferred until 1962) is again the host.

As in previous years, attendance of personnel of Army and other governmental agencies will be by invitation. Quotas will be set for each Army R&D activity not to exceed a total of

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Service R&D Chiefs Stress Fully Coordinated Efforts In Series of Discussions

Tri-service cooperation in research and development activities is taking on a new depth of effort growing out of recent meetings of R&D leaders of the Army, Air Force and Navy to map plans for broad coordination.

Chief of Research and Development Lt Gen William W. Dick, Jr., has been engaged in a series of meetings with Rear Adm C. T. Booth, Deputy Chief of Naval Operations (Development), Lt Gen James Ferguson, Air Force Deputy Chief of Staff for Research and Development, and an Ad Hoc Committee.

Discussions will be on a continuing basis to consider ways and means of improving lateral communications and achieving better coordinated efforts in the research, development, testing and evaluation (RDT&E) area for the most efficient utilization of available resources and capabilities.

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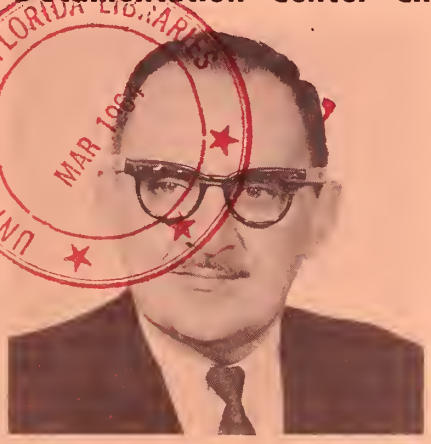
Documentation Center Chief Effects Staff Changes



Armen Gregory Abdian

Defense Documentation Center key staff changes expected to follow the recent appointment of Dr. Robert B. Stegmaier as administrator have made Armen Gregory Abdian his deputy and moved other employees.

Experience of Mr. Abdian for his new position spans more than 20 years, beginning with World War II service in the Office of Censorship in Hawaii, where he supervised code-breaking operations. That led to assignment as chief of the analytic section, Office of Censorship in Washington, D.C. Later he was chief postal censor, U.S. Zone of Germany.

After returning to the United

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Featured in This Issue . . .

U.S. Ambassador Greets Students in Japan

U.S. Ambassador to Japan Edwin O. Reischauer greets U.S. science students Rhea Keller (Army), Eric Sundberg (Air Force), and Paul Roling (Navy) at U.S. Embassy visit during recent Japan Student Science Awards in Tokyo. The students were praised for their effectiveness in building good will as "ambassadors" of the Armed Services and representatives of the National Science Fair-International, as well as for their scientific achievements.

Army R&D Newsmagazine

Vol. 5, No. 1 Dec. 63-Jan. 64

Editor . . . . . Clarence T. Smith

Ass't Editor . . . . George J. Makuta

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Purpose: To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among the widely dispersed and diffused Army R&D activities; to maintain a closer link from top management through all levels to scientists, engineers and technicians at the bench level; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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By-lined Articles: Accuracy and relevancy of contents of this publication to accomplishment of the Army R&D mission are of constant concern to the editors. Primary responsibility for opinions of by-lined authors rests with them; their views do not necessarily reflect the official policy or position of the Department of the Army.

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Distribution requirements for the Office of the Secretary of the Army, Under Secretary of the Army, Assistant Secretary of the Army R&D), Chief of Staff, Chief of Research and Development, and Chief of Information will be submitted by the Office of the Chief of Research and Development.

All other Department of the Army agencies should submit their requirements through channels to the Army Publications Distribution Center servicing them.

Changes in requirements of other Government agencies should be submitted directly to the Army Research Office, OCRD, Department of the Army, Washington 25, D.C., ATTN: Scientific and Technical Information Division.

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What Type of Engineers Are Needed in R&D Labs

R&D Directorate, U. S. Army Missile Command
By John L. McDaniel, Technical Director

Viewpoints expressed by John L. McDaniel on engineering requirements in Army laboratories are backed up by experience acquired in continuous employment at the U.S. Army Missile Command since 1942, except for a 2-year stint in the Navy.

A native Alabaman, he attended Berry College in Mt. Berry, Ga., and received a B.S. degree in chemistry in 1939. After teaching school in La-Fayette, Ga., for three years, he started his career at Redstone Arsenal.

Most of his experience has been gained in research assignments, and he was an aeronautical research engineer until he was named deputy director for R&D Operations for the Army Ballistic Missile Agency. When that Agency was absorbed in the creation of the Army Missile Command, he assumed his present position.

John L. McDaniel

The word laboratory in the Defense context has many meanings. Used in general terms, it encompasses the full spectrum of weapon technology from basic research through production. Further, each service has problems unique to its missions, and distinct requirements for its laboratories.

Naturally, this article concerns Army laboratories in general and missile laboratories of the Army Missile Command at Redstone Arsenal, Ala., in particular. I believe, however, it is sufficiently broad to be useful in a general discussion of defense research and development facilities.

R&D laboratories of the Army Missile Command are an organic part of a Commodity Command. Our commodity is missiles. Therefore, it is a responsibility of our laboratories to concern themselves with missions which cover first, research; second, the generation of new missile concepts to fulfill the requirements unique to the future Army; and third, the technical support required in the fielding of missile systems now in development.

In carrying out this broad mission, the laboratories must be constantly mindful of the system characteristics which assure that the weapon will be reliable anywhere in the world.

The formula for discharging this responsibility contains many terms. One of these is men, and it is this term that we will discuss. Successful operation of R&D laboratories requires teamwork of men. Our team is made up of men and women trained in the physical sciences and in the various fields of engineering. The engineer is now a major rather than a casual partner of this team.

My first requirement for an engineer for R&D laboratories is an individual to work as a team member in providing reliable weapon systems. To operate effectively as a member of this team the engineer must have a fair amount of formal education, and a great amount of appreciation for physical sciences and statistics.

The engineer plays a key role in the area of reliability. Reliability is a function of the Army's decision from beginning to end. Men experienced in this unique business can look objectively at a development program, almost before it begins, and identify the reliability problems they can expect to encounter.

Reliability must be built into all the decisions which are made for an entire program through design, tests of successive stages of design, through corrections made during design, through further testing, through production and the assurance of quality production, through protection of quality in the supply net.

A second desirable characteristic for an engineer in the R&D laboratories is an individual trained in reliability as this relates to a weapon system throughout its life cycle.

Decisions regarding missile systems generated by the R&D laboratories must be made by men who have to stand up and be counted by the men who must answer to the combat soldier who takes the missile system onto the battlefield. We cannot have those decisions made for us by other people. These decisions

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96 Selected to Give Army Science Conference Papers

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500, the maximum Academy facilities can accommodate.

Sponsored by the Chief of Research and Development, the conference is designed to disseminate information on significant Army R&D progress, and to stimulate integrated, coordinated effort directed toward the goal of minimizing duplication or overlapping of activities, in the interest of economy.

The discussions serve also to promote understanding of the depth and scope of the overall Army R&D program, to focus attention on the importance of maintaining a strong in-house R&D capability, to establish closer rapport among scientists, engineers and management personnel through association, and to stimulate pride in Federal Civil Service careers.

Arrangements for the parley are again being made jointly by the Academy and the U.S. Army Research Office Scientific Information Division, acting on behalf of the Chief of Research and Development. The Academy committee is headed by Lt Col B. F. Hood, assistant deputy chief of staff, Personnel Administration.

The Army Research Office committee is headed by Dr. Ivan R. Hershner, scientific director, backed up by Lt Col W. G. Van Auken, acting chief of the Special Activities Branch, and Jack Fenn, his deputy.

Dr. Hershner also heads the 1964 Army Science Conference Advisory Group, which selected the 96 papers that will be presented. Other members are Gilford E. Quarles, chief scientific adviser, Office of the Chief of Engineers; Dr. Marion B. Sulzberger, technical director of research, Office of the Surgeon General; Dr. Craig M. Crenshaw, chief scientist, U.S. Army Materiel Command.

Army Materiel Command personnel presented 301 of the narrative summaries of proposed papers; only 117 were submitted to the Advisory Group in the preliminary screening process within the AMC, and 79 were chosen for presentation.

Of the remaining papers, six will be representative of the Office of the Chief of Engineers, eight are by personnel of the Office of the Surgeon General, and three from other units.

Four additional presentations, making a total of 100, are on the tentative program, one as the keynote address, the others by eminent guests.

The Association of the United States Army, which has supported the honorarium requirements for military authors of papers ever since the Army Science Conference was initiated, has again given assurance of assistance.

In 1962 the top technical paper individual award of $500 was won by an enlisted scientist, Sp/4 Ira C. Felkner of the U.S. Army Biological Laboratories at Fort Detrick, Md. Other military authors shared $591.

Similar cash honorariums for prize-winning papers presented by civilian scientists will be presented through the Army's Incentive Awards Program. Four $500 awards and seven $300 awards were made in 1962, several of them team awards. Sixty Certificates of Achievement signed by the Assistant Secretary of the Army (R&D) and the Chief of Research and Development were given.

Titles of the 96 papers selected for presentation at the 1964 conference and the authors are:

CHEMICAL AND MOLECULAR ACTION —Molecular Mechanisms of Antimicrobial Action, Fred E. Hahn, Walter Reed Institute of Research (WRAIR). The Molecular Basis for the Low pH Alteration of Alpha Lactalbumin, Martin J. Kronman, Lee Holmes, Robert Blum, Raymond Andreotti and Rasma Vitols, U.S. Army Natick Laboratories. Preparations and Uses of Some New Organolead Chemicals, Malcolm C. Henry and Kenneth Hills, Natick Laboratories. High-Speed Penetration of Nonwoven Fabrics, Roy C. Laible, Natick Laboratories.

SHOCK, IMMUNIZATION, BEHAVIORAL SCIENCES—Influence of Trauma and Hemolysis on Hemorrhagic Shock, Col Robert M. Hardaway, WRAIR. Graft Rejection in the Fetal Lamb, Dr. Arthur M. Silverstein, Armed Forces Institute of Pathology (AFIP). Information Assimilation from Command Systems Displays, Seymour Ringel, U.S. Army Personnel Research Office (APRO). Auditory Research with Animals, John J. Romba, Human Engineering Laboratories (HEL).

TOXIN, MECHANISM ANTIMICROBIAL ACTION—The Purification and Characterization of Staphyllococcal Enterotoxin B, Edward J. Schantz, William G. Roessler, Jack Wagman, Leonard Spero, David Stefanye, David A. Dunnery and Merlin S. Bergdoll, U.S. Army Biological Laboratories. The Mechanism of Action of Staphylococcal Enterotoxin, Type B II, Distribution into the Tissues, 1st Lt Gerald J. Crawley and 1st Lt Wayne LeBlang, U.S. Army Medical Unit, Fort Detrick. The Influence of Storage, Aerosolization, and Rehydration on the Permeability of *Pastuerella Tularensis*, Dora K. Hayes and Victor J. Cabelli, Dugway Proving Ground. An Investigation of Aerosols of Viruses Disseminated in Very Small Particles, Milton E. Prickett, Biological Laboratories.

INFECTIONS — The Effect of Migrating Nematode Larvae as a Provoking Factor in Viral Encephalitis, Maj Bryce C. Walton, Medical Unit, Panama. The Effect of Hyperthermia on Protein Turnover in Infection, Col Irving Gray and Capt Paul V. Hildebrandt, Medical Unit, Fort Detrick. The Morphologic Response of the Gastointestinal Tract of Ten Day Old Rabbits to Intact and Ultrasonically Disrupted Cholera Vibrios Their Cell-Free Filtrates and Cholera Endotoxin, Capt Thomas Norris, Dr. R. A. Finkelstein and Col H. Sprinz, WRAIR. Growth of Selected Group A Arboviruses in Serum-Free Suspension Cell Cultures, H. R. Tribble, Jr., S. C. Nagle, Jr., H. J. Hearn, Jr., and W. T. Soper, Biological Laboratories.

RADIATION — The Response of Selected Gamma Radiation Detectors to Radiation Delivered at Very High Dose Rates, H. J. Donnert, N. Klein and R. A. Sasse, Nuclear Defense Laboratory (NDL). Radiation Biodosi-

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Newsmagazine Staff Thanks Many Aides for Progress

In the introductory issue of the *Army Research and Development Newsmagazine*, the editor wrote that whatever success the publication achieved would be due to contribution of material from many sources.

During the three years since that time, a gratifying number of letters of approbation have come from military leaders, scientists, engineers and representatives of top management in the U.S. and foreign lands.

Based on three readers for each copy (considered a conservative figure), it is estimated that about 100,000 persons gain an understanding of Army research and development by relying on this publication.

Credits to all of the persons who have contributed to the growth of the Newsmagazine might fill several pages. First of all would come Lt Gen Arthur G. Trudeau, former Army Chief of Research and Development, who gave his strong support, as did his successor, Lt Gen Dwight E. Beach, along with all OCRD leaders at directorate level.

Much more than a passing word of thanks would go also to William J. Donohoe of the Office of Freedom of Information, Office of the Chief of Information, Department of the Army, and Eugene F. Hart, former information officer for the Deputy Chief of Staff for Logistics now occupying a similar post for the Supply and Maintenance Command. Both gave invaluable aid in facilitating the flow of material and expediting clearance procedures.

With the activation of the U.S. Army Materiel Command in 1962, and the resultant phaseout of Technical Services functions in materiel R&D except for the Army Medical Service, equally vigorous support has come from that command. Lt Gen Frank S. Besson, Jr., CG of the AMC, and Col Robert J. Coakley and Donald Craig of the AMC Information Office, have given continuing assistance.

Walter Willis and L. V. Naisawald of the OCRD Technical and Industrial Liaison Office merit a resounding word of thanks for their help in coordinating articles for accuracy and policy requirements within OCRD.

To these and many, many others, this occasion calls for "Thanks!"

Documentation Center Chief Effects Staff Changes

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States in 1947, he served with the Library of Congress, Atomic Energy Commission and National Science Foundation. In 1961 he left Government service to become director of research, Institute for Advancement of Medical Communication in New York City.

In that capacity he and Dr. Stegmaier worked together as members of a task force that prepared for the President's Science Advisory Committee and the Federal Council on Science and Technology a key study paper in the program to systematize scientific and technical informaton programs of the Federal Government.

Leaving the Institute in 1962, Mr. Abdian took a position as vice president and consulting specialist with Herner and Co., Washington, D.C. Later he became a private consultant in the field of information systems, services and resources.

A native of Somerville, Mass., he was graduated from Harvard University with a degree in biochemical sciences. He has written for technical journals and has presented papers on scientific and technical information before many professional societies.

OTHER IMPORTANT CHANGES in DDC key personnel include assignments to other agencies of Dr. Charles N. Bernier, who served as director of ASTIA until that agency was redesignated the DDC on Mar. 27, 1963; J. Heston Heald, who was ASTIA technical adviser; and Julius Frome, ASTIA and subsequently DDC deputy for science and technology.

J. Heston Heald assumed new duties Dec. 2 as deputy to the Defense Director of Technical Information, Walter M. Carlson, taking over the vacancy created when Dr. Stegmaier left to become DDC administrator.

Dr. Bernier is detailed from the DDC to a new job in January as chief of Scientific Centers Programs and acting associate director for communication, National Institute for Child Health and Human Development, National Institutes of Health, Washington, D.C. Julius Frome is scheduled for a new job, also at NIH, with the National Institute of Mental Health.

Dr. Stegmaier announced a number of additional changes in mid-December. Herbert Rehbock became acting director of Document Analysis and Processing. Roy H. Chapman was named acting director of User Document Service. William A. Barden took over as acting director of Automated Systems and Services.

In staff level changes, Leroy R. Barnes became acting director of Planning and Management, Claude A. Albert acting director of the Office of the Comptroller, Mr. Major T. Martin assistant director of the Office of Administrative Services, and Franklin E. Jordan acting special assistant for public affairs.

Army Spurs Helicopter Industry

U.S. Army helicopter contracts for FY 1963 totaled $212,500,000 and are programed to jump to $311,800,000 during FY 1964, an increase of 46.7 percent, in line with the Army air mobility goals set in 1960. Army purchases currently represent about 70 percent of all helicopter purchases in the Nation and about 80 percent of military 'copter buying.

Defense R&D Leaders See Situation in Far East

Defense Director of Research and Engineering Dr. Harold K. Brown, Secretary of the Army (R&D) Willis M. Hawkins and Army Chief of Research and Development Lt Gen William W. Dick, Jr., returned Dec. 17 from a 17-day Far East tour.

In Japan where the U.S. Army R&D Group is headquartered near Tokyo, they were briefed on operations, particularly on medical aspects of environmental research, by Group Commander Col Arvey C. Sanders.

Before leaving for his present assignment more than three years ago, Col Sanders was assigned to Army Research Office, Washington, D.C. Former director of Army Research Maj Gen C. W. Clark, now CG of the U.S. Army, Japan, met with the visitors at a luncheon.

Nike Zeus installations on Kwajalein were inspected by the trio of R&D leaders, including the various supporting installations. Most of the tour was centered in Viet Nam to study R&D supporting activities of U.S. Forces.

A full-scale demonstration of tactics employed in guerrilla warfare in Viet Nam was staged by the commanding general of their officer candidate school. During a trip to the Delta Region near Saigon, the visitors discussed military problems with Corps and Division commanders, and made observations of one of the "strategic hamlets."

Officers representing the Combat Developments Command arranged a full-scale demonstration of weapons used in the Viet Nam fighting.

Defense Director of Research and Engineering Dr. Harold Brown (above, left) and Assistant Secretary of the Army (R&D) Willis M. Hawkins chat with Maj Gen C. W. Clark, CG of the U.S. Army Japan and former Director of Army Research, during a stopover visit at Camp Zama near Tokyo while en route to Viet Nam. At right, Chief of Research and Development Lt Gen William Dick, Jr., a member of the inspection group, confers with Col Arvey Sanders, commander of the U.S. Army R&D Group, Far East. General Dick follows the R&D leaders' policy of wearing "civies" on TDY abroad.

96 Selected to Give Army Science Conference Papers

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metry, Hillel S. Levinson and Esther B. Garber, Natick Laboratories. The Effects of Acute and Massive Doses of Ionizing Radiation on Conditioned Avoidance Behavior of Primates, Capt J. C. Sharp and Lt Col Joseph V. Brady, WRAIR. Potential Radiation-Protective Compounds. Synthesis of the Three Isomeric Three-Carbon Aminohydroxy Bunte Salts and Related Compounds, D. H. Ball, J. M. Williams and L. Long, Jr., Natick Labs.

TOXIC AGENTS — Destruction of Toxic Agents and Model Compounds with Chlorine Dioxide, Virginia E. Bauer, Joseph Epstein, David H. Rosenblatt, George T. Davis, Larry A. Hull, Raymond C. Weglein and Donald C. DeLuca, Chemical Research and Development Laboratories (CRDL). Incapacitating Agents: Eight Stereoisomers of a Synthetic Tetrahydrocannabinol, Herbert S. Aaron and C. Parker Ferguson, CRDL. Casualty Estimations for Chemical (GB) Munitions Delivery Systems, Keith Myers, U.S. Army Ballistic Research Laboratories (BRL). Design and Reaction Mechanism of Short-Lived Alkylating Agents, Charles E. Williamson, Jacob I. Miller, Samuel Sass, and Benjamin Witten, CRDL.

PHYSICS-ELECTRONICS—Functional Dependence of the Radar Cross Section of the Wake of a Re-entry Vehicle on CdA*, R. L. Edwards, U.S. Army Missile Command. Accuracy and Information Rate Studies on Target Cross Sections Utilizing the Nike Hercules Radars, G. E. Galos, White Sands Missile Range (WSMR). Re-entry Vehicles for Radar Selectivity Evaluations, R. M. Colton, Watertown Arsenal. Mechanism of Preferential Ablation, B. Steverding, Missile Command.

Retrofugal Electron Flux from Massive Targets Irradiated with a Monoenergetic Primary Beam, Dr. R. W. Dressel, WSMR. Relaxation Processes in Ferromagnetic Insulators, Joseph Nemarich, Harry Diamond Laboratories. Surface Dependence of Magnetostatic Mode Linewidths in Yttrium Iron Garnet, George R. Jones, Harry Diamond Laboratories. High Power Microwave Device Applications for New Narrow Resonance Linewidth Hexagonal Ferrites, Samuel Dixon, Jr., Robert O. Savage, Jr., and Arthur Tauber, U.S. Army Electronics Research and Development Laboratories (USAELRDL).

Analysis of Magnetic Signals from the High-Altitude Nuclear Tests of Operation Dominic, Dr. H. A. Bomke, I. A. Balton, H. H. Grote and A. K. Harris, USAELRDL. Ballistic Procedures for Unguided Rocket Studies of Nuclear Environments, Otto W. Thiele, WSMR. Absorption of AICBM Radar Frequencies by High Altitude Nuclear Fireballs, R. J. Clawson, WSMR. Determination of the Ionospheric Electron Content Utilizing Satellite Signals, P. R. Arendt, A. Papayoanou and H. Soicher, USAELRDL.

X-Band Semiconductor Switching and Limiting Using Waveguide Series Tees, V. J. Higgins, USAELRDL. TE_{01} Cross-Guide Transducer and Isolator, J. P. Agrios, C. D. Neudorfer and R. A. Stern, USAELRDL. Monocycle Position Modulation, W. A. Huber, USAELRDL. Electronic Counter Countermeasures Design Techniques for Communications, John J. Egli, USAELRDL.

Applications of Light-Emitting Diodes to Certain Infrared Communications and Surveillance Problems, B. Bluford, Jr., USAELRDL. Performance of the Germanium-Photovoltaic Cell under Intensive Monochromatic Light, K. J. Brzonkala and Emil Kittl, USAELRDL. Superconductors in Advanced Electronics, Dr. G. K. Gaule, J. T. Breslin, R. L. Ross and R. S. Logan, USAELRDL. Fluorine Hyperfine Interaction in Electron Spin Resonance, Robert Lontz, U.S. Army Research Office-Durham (AROD).

The Use of Intense Pinch Discharges for Laser Illumination, Dr. R. G. Buser, J. J. Kainz and J. J. Sullivan, USAELRDL. Direct Modulation of a Helium-Neon Gas Laser, E. J. Schiel, USAELRDL. Optimization of the Rotating Reflector Q-Switch, D. A. Reago, E. Green and M. Schoenfeld, Frankford Arsenal. Ruby Laser with Piezoelectrically Excited Vibrating Reflector, Dr. E. A. Gerber and E. R. Ahlstrom, USAELRDL.

CHEMISTRY, MATERIALS AND POWER SOURCES — Gas Velocity Probe, C. Cason, Missile Command. Evaporation of Organic Compounds from Metal Surfaces at High Vacuum, Dr. H. Gisser and S. Sadjian, Pitman-Dunn Laboratory. Hydrogen-Metal System Dependence on Discharge Parameters, Sol Schneider, John E. Creedon and Norman L. Yeamans, USAELRDL. A Novel Process for Ultra-Fine Crystallites, and Their Theory and Application in Magnetic Ferrites, W. W. Malinofsky, R. W. Babbitt and G. C. Sands, USAERLDL.

Control of Propellant Quality by X-Ray Fluorescence Analysis, B. J. Alley, Missile Command. The Maximum Dissociation Energies of Transition Element Diatomic Molecules, A. Kant and B. Strauss, Watertown Arsenal. The Effect of Alloy Segregation on Spalling of Metallic Armor Materials, K. H. Abbott, Watertown Arsenal. The Recovery of the Attenuation of Copper Single Crystals Following Small Plastic Deformation Studied by the Ultrasonic Pulse Method, Julius Frankel, Watervliet Arsenal.

Radiation Enhancement of Catalytic Activity, Studied by Means of Gas Adsorption, D. B. Rosenblatt and G. J. Dienes, Pitman-Dunn Laboratory. A Paramagnetic Resonance Study of Nitrogen Atoms Trapped in X-Irradiated Alkali Azides, F. F. Carlson, U.S. Army Engineer Research and Development Laboratories (ERDL). Hindered Rotation in Aminoboranes, Dr. J. W. Dawson and Dr. Kurt Niedenzu, AROD. Measurements of True Dark Conductivities in Ferrocene Crystals, Edwin Zehler and Claire L. Burke, USAELRDL.

Morphology of Dendritic Structures in High-Strength Steels, Paul J. Ahearn and Francis C. Quigley, Watertown Arsenal. Biaxial Tensile Behavior of Anisotropic Titanium Alloy Sheet Materials, J. L. Sliney, Watertown Arsenal. The Strain Rate Sensitivity of the Mechanical Properties of High Strength Alloys as a Function of Strength Level and Composition, David Kendall, Watervliet Arsenal. Study of the Effect of Extreme Pressure on the Structure and Properties of Metals, Tom Davidson, Watervliet Arsenal.

On the Chemical Structure of Lead Styphnate, T. A. Richter, M. Warman and E. J. Sowinski, Picatinny Arsenal. Amino-Nitrogen-15 Tracer Studies of the Nitrolysis of Hexamethylenetetramine, T. C. Castorina and J. R. Autera, Picatinny Arsenal. Phosphorus, Arsenic, and Boron-Containing Ferrocene Derivatives by Friedel-Crafts Reactions, G. P. Sollott, J. L. Snead, S. Portnoy, W. Peterson and H. E. Mertwoy, Pitman-Dunn Laboratory. Preparation of 5-Dinitromethyltetrazole from Salts of Dinitroacetonitrile, Fred Einberg, Pitman-Dunn Laboratory.

A New Fuel for High Energy Rocket Propellants, Clay D. Howard and Chester W. Huskins, Missile Command. Effect of Filler Concentration on the Viscoelastic Response of a Composite Solid Propellant, Donald L. Martin, Jr., Missile Command. The Effect of Binder Crystallization on Solid Rocket Propellant Grains, Henry C. Allen, Missile Command. Characterization of Nitrogen-Fluorine Containing Compounds as Propellants, Barry D. Allan, Edgar F. Croomes, William A. Duncan, James A. Murfree, Billy J. Sandlin and Walter W. Wharton, Missile Command.

ENVIRONMENTAL, BALLISTICS, ENGINEERING—Closed Cycle Gas Turbine, W. M. Crim, Jr., Nuclear Power Field Office. A New Gravity Meter, Henry P. Kalmus, Harry Diamond Labs. Design of a Nonmagnetic Compass, Leon Horn and Harry J. Davis, Harry Diamond Labs. Interpretation of Aerial Imagery of Sea Ice, V. H. Anderson, Cold Regions Research and Engineering Laboratory (CRREL).

On the Interaction of a Bow Shock of a Re-entry Body and a Blast Wage, Lt Thomas Taylor, Picatinny Arsenal. An Optical Recording System for Measuring the Angular Motions of the Gun Tube and the Projectile in the Tube, Stanley S. Lentz, BRL. Performance Evaluation of a Special Armor System, S. M. Keithley, Aberdeen Proving Ground. An Electrostatic Fuze for Antiaircraft Mines and Other Antiaircraft Weapons, E. B. Rogers, Harry Diamond Labs.

Optical-Electronic Azimuth and Distance for Non-intervisible Distant Stations, Emanuel M. Sodano, Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA). Mesometeorological Applications of IR Instrumentation, Dr. Helmut K. Weickmann, USAELRDL. Numerical Solution of the Distribution of Wind and Turbulence in the Planetary Boundary Layer, James F. Appleby and William D. Ohmstede, Fort Huachuca, Ariz. Modern Research Areas in Atmospheric Electricity, Dr. Heinz W. Kasemir, USAELRDL.

Friction Hydro Pneumatic Suspension System, Maj William J. Hart, Jr., U.S. Army Mobility Command. An Hypothesis Relating the Interacting Effects of Air Content and Water Content on the Strength of Portlandcement Concrete, Bryant Mather, Waterways Experiment Station. Nuclear Weapons Effects on Dams, W. J. Flathau and J. N. Strange, Waterways Experiment Station. Laboratory Investigation of the Mobility of Pneumatic Tires in Cohesionless Soil, D. R. Freitag and C. J. Powell, Waterways Experiment Station.

Boundary Layers in Couple-Stress Elasticity and Stiffening of Thin Layers in Shear, Youn-Chang Hsu, Moayyed A. Hussain and Michael Sadowsky, Watervliet Arsenal. Modal Analysis of Transient Vibrations in a Linearly Visco-elastic Solid, A. S. Elder, BRL. Surge Waves in Automatic Weapons, Edwin H. Jakubowski and Henry P. Swieskowski, Springfield Arsenal. Some Predicted Blast Properties of Pentolite and Their Comparison with Experiment, R. T. Shear, BRL.

The Realization of Active Seismic Systems and Their Practical Applications, Dr. K. Ikrath and W. Schneider, USAELRDL. High Altitude Ionization Associated with Nuclear Detonations, Warren G. Berning, BRL. Shock Transmission in Laboratory Simulating Devices, T. E. Kennedy, Jr., and W. J. Flathau, Waterways Experiment Station. New High-Altitude Fast-Rising Balloons, Moses Sharenow, USAELRDL.

ASA (R&D) Credits Newsmagazine for Hewing to Goals

In the first issue of the *Army Research and Development Newsmagazine*, Mr. Richard S. Morse, then Director of Research and Development, stated:

"This monthly periodical should perform a most valuable service in presenting reports on significant gains, overall progress and objectives, the views or policies of management, measures being taken to cope with problems of interest to all personnel, and accounts of how people are accomplishing their jobs and gaining deserved recognition."

During the three years since this opinion was given, the *Army R&D Newsmagazine* has more than quadrupled the distribution originally envisioned. Much of this success is due to the excellent reporting of personnel news at all echelons within the Army R&D community. Such complete coverage reflects the interests and cooperation of several thousands of workers in the vast complex of Army R&D activities.

I congratulate all who have contributed to the success of the *Army R&D Newsmagazine.*

Willis M. Hawkins
Assistant Secretary of the Army
(Research and Development)

Briefing of Generals Accents AE-R&D Career Program Benefits

Success tips to ambitious officers on how to start the New Year, based on a recent briefing of six generals on U.S. Atomic Energy and Research and Development Programs, might include: "Take a good look at these!"

Advancement opportunities for qualified officers were outlined in a presentation originally scheduled for 20 minutes and extended to 90 minutes to meet the generals' desire for a comprehensive view of the AE-R&D Officer Specialist Programs.

Initiated under provisions of Army Regulation 614-135, the AE Program was launched in 1953 and the R&D Program in 1955. Currently 174 officers are enrolled in the AE Program and 375 in the R&D Program. Indications are that a full-scale effort is underway to increase these totals in order to align program strength with existing and predicted needs.

Chief of Research and Development Lt Gen William W. Dick, Jr., and Maj Gen A. S. Collins, head of the Officer Personnel Directorate, Office of Personnel Operations (OPO) listened to Lt Col Willis L. Paul explain the AE-R&D Programs.

As chief of the Scientific and Technical Section, Specialist Branch, OPO, Col Paul has responsibility for the AE-R&D Programs. In this activity his counterpart within the Office of the Chief of Research and Development is John W. Green, assistant executive for administration.

Deputy CRD Maj Gen George W. Power, Director of Special Weapons Brig Gen William T. Ryder, Director of Plans and Programs Brig Gen Raymond B. Marlin, Director of Army Research Walter E. Lotz, Jr., and Director of Developments Col Allan G. Pixton were among OCRD leaders present at the briefing.

Col Paul can cite an impressive list of outstanding officers who have advanced through participation in the AE-R&D Programs, including Brig Gen Robert E. Coffin and Brig Gen John C. Dalrymple, both promoted in January 1963. Brig Gen James A. Hebbeler was promoted in November when he became commander of the Deseret Test Center at Salt Lake City, Utah.

The most notable example recently is Col John K. Boles, nominated Nov. 1 for promotion to brigadier general. For more than three years he served as executive officer in OCRD, prior to assignment to the Office of the Joint Chiefs of Staff where he is currently assigned as deputy chief of Requirements and Developments, J5.

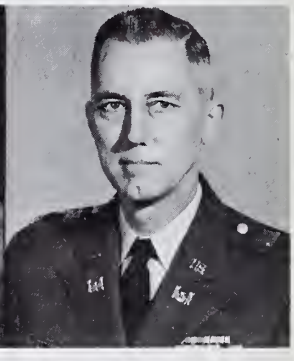
Brig Gen J. A. Hebbeler

Col J. K. Boles, Jr.

Lt Col H. H. Cooksey

Lt Col R. Ray

John W. Green



Lt Col W. L. Paul

One of the basic concepts of Army R&D operations is teamwork at all echelons to combine talents of military and civilian scientists, engineers, technicians and management personnel. The AE-R&D Programs are designed to insure a continuing "hard core" of professionally trained and experienced officer personnel.

This corps of talent is part of the defense team which includes civilian scientist programs referred to in page 1 lead stories in the August and September 1963 issues of this publication, titled: "Plans for Career Program for Scientists Nearing Completion" and "Army Prepares Pilot Program Geared to DoD Goals of Career System for Project Management Offices."

OPO has underway a worldwide survey of R&D "controlled" positions within the Army for easy and rapid identification of vacancies that can best be filled by AE-R&D Program personnel. "Key" R&D positions (high authority and responsibility as managers or commanders) are likewise being identified worldwide.

Being conducted also is a review of specialized qualifications of personnel in the program to facilitate assignments.

The overall objective of these studies, Col Paul explained, is twofold: To give officers enrolled in the AE-R&D Programs a clearer sight of the various career advancement possibilities open to them; and to enable using agencies in the field to quickly identify critical positions, permitting more selective assignments of officers.

In this manner a "firm career ladder" is established for those enrolled in the AE-R&D Programs. Emphasis also is on the fact that participants can achieve key R&D positions "without prejudicing in the least their opportunities for advancement in their particular career branches."

In accordance with qualification criteria set forth in AR 614-135, qualified officers are encouraged to volunteer for the AE-R&D Programs at anytime after three years of active service. Reserve Officer Training Corps graduates in science and engineering thus present an excellent potential for the programs.

An indication of the overall potential of officers who might qualify for participation in the programs was provided by a survey which showed that 3,900 have advanced scientific

and technical degrees. These officers are being screened and letters of invitation to enroll are planned.

Officers otherwise qualified usually should have not more than 21 years of military service. Exceptions are made for abilities and potential.

A statistical breakdown of participants showed, as of Oct. 1, 1963, there were 43 colonels, 67 lieutenant colonels, 42 majors and 18 captains in the AE Program. In the R&D Program, 102 were colonels, 137 lieutenant colonels, 91 majors, 45 captains and one a first lieutenant.

Further, in both programs, 149 were in Artillery, 130 in Ordnance, 67 in Infantry, 48 in the Chemical Corps, 36 in Armor, 35 in the Corps of Engineers, 33 in the Signal Corps, 23 in Transportation, 6 in the Medical Service, 2 in the Adjutant General Corps and 1 in Finance.

Among listed "Benefits from Achievement of Goals" for the programs outlined at the briefing of the six generals were:

- Motivate young officers who aspire to high-level scientific and technical positions; attract young officers to the program and develop their skills through controlled assignments.
- Assure effective utilization of qualified senior scientific and technical officer personnel.
- Induce greater emphasis on selectivity in filling critical positions.
- Provide a base for a) determining total requirements for scientific and technical officer personnel, and b) establishing optimum size (strengths) of the AE-R&D Specialist Programs.
- Serve to guide and direct officers aspiring to high-level specialty assignments.

In commenting on purposes of the programs, Lt Col Paul stated:

"Requirements are indicated for more than 2,000 officers in Army R&D assignments and a somewhat lesser number in the atomic energy field. It is not our intent to enroll this many officers in the specialist programs, but a hard core of special talent is desired for critical needs.

"Allocation of about one-seventh of the current annual defense budget to military R&D emphasizes the need for talented officers and suggests virtually unlimited opportunities for enrollees in the specialist programs.

"The officer who wishes to contribute his scientific and technical talents to the technological progress of the Army and the Nation will find full opportunity to do so as a member of either of these specialist programs."

AE Program selectees for promotion to colonel in 1963 included Richard E. Cook, Roger Ray and William G. Senior. In the R&D Program the colonels list included 22 persons, namely: Paul Autrey, Harry C. Beaumont, Robert E. Bennett, James R. Buntyn, Edwin B. Buttery, Howard H. Cooksey, James O. Daulton, and

Vincent H. Ellis, John W. Ervin, Raymond S. Isenson, John F. Kuznicki, Albert C. Lane, William B. Levin, Robert W. McEvoy, Walter E. Mehlinger, Arthur F. Mitchell, James D. Neumann, Cornell Pope, Jack R. Riggins, Michael J. Strok, Jesse L. Walters and William H. Woodward.

Eighteen officers were selected in 1963 for military schools to increase their capabilities for assignments of progressively increasing responsibility. In the following listing, AEP stands for Atomic Energy Program and RDP for the Research and Development Program.

National War College: Lt Col Jelks H. Cabaniss, Jr., and Lt Col William P. DeBrocke, RDP. *Industrial College of the Armed Forces:* Lt Col Roger Ray, AEP; Lt Col Spencer R. Baen and Lt Col Ephraim M. Gershater, RDP. *Air War College:* Lt Col Frank D. Conant, Jr., AEP, and Lt Col Joseph E. Fix, III, RDP.

Army War College: Lt Col Harry C. Smythe, Jr., Lt Col John F. Kimbel and Lt Col William C. Abernathy, AEP; Col William M. Boggs, Lt Col Roy L. Baber, Jr., Lt Col William H. Holcombe, Jr., Lt Col William H. Woodward, Lt Col James D. Neumann, Lt Col William H. Young, Lt Col Donald H. Steininger and Lt Col James L. Jones, RDP.

Thirty-nine officers enrolled in the programs during 1963, namely. AEP —Lt Col Charles J. Bliss, Lt Col Richard H. Cook, Maj William H. Travis and Capt Burton J. Conway.

RDP—Col George D. Carnahan, Col Thomas E. Marfing, Lt Col Henry F. Grimm, Jr., Lt Col John W. Oswalt, Lt Col John P. Crespell, Lt Col Robert W. Reisacher, Lt Col Edmund K. Ball, Lt Col Gordon A. Schraeder, Lt Col Robert L. Allen, Lt Col Robert W. Samuel, Lt Col Raymond J. Astor, Lt Col Willis H. Clark, and Lt Col Gerson K. Heiss;

Maj Harold W. Shear, Maj Charles K. Woody, Maj Morris J. Keller, Maj Donald N. Gower, Maj Jerry H. Berrier, Maj Adalbert E. Toepel, Jr., Maj Lavern R. Riesterer, Maj Henry F. Magill, Maj Joseph A. Gappa, Maj Francis C. Alford, Jr.;

Capt Herman E. Day, Jr., Capt Karl R. Klose, Capt William F. Fiorentino, Capt Lionel R. Coule, Capt Karl F. Prunitsch, Capt Malcolm V. Meekison, Capt John R. Bray, Capt Robert C. Tilton, Capt Gerald Z. Demers and 1st Lt Carl Wesemann.

MOCOM Realignment Shifts 3 R&D Missions to ERDL

The U.S. Army Mobility Command Engineer Research and Development Laboratories (USAERDL) at Fort Belvoir, Va., acquired three new missions in mid-December.

Maj Gen Alden K. Sibley announced that research and development responsibilities for amphibious, rail and marine mobility materiel have been transferred to the Laboratories from the U.S. Army Transportation Research Command (TRECOM), Fort Eustis, Va.

The Marine and Amphibious Research Group is concerned with the analysis and evaluation of marine transport operations, equipment, systems and facilities to develop optimum marine and amphibious vehicles. It also develops research test beds and prototypes for marine, inland waterways and amphibious equipment. The Rail Group, which was relatively inactive recently while at Eustis, is concerned with railroad developments.

The transfer is a result of a realignment of the Mobility Command to consolidate management of common items of materiel. TRECOM will become, in effect, a research and development directorate of the present Aviation and Surface Materiel Command (AVSCOM), headquartered in St. Louis, Mo. In turn, AVSCOM responsibilities for maintenance, procurement and supply of amphibious, rail and marine materiel will be transferred to a new center to be activated in St. Louis.

The new center will be composed of personnel and elements of the present U.S. Army Engineer Supply Control Office (ESCO), roughly 1,000 personnel space from the Mobility Support Center (MSC) being deactivated at Columbus, Ohio, and 400 AVSCOM personnel. No transfer of USAERDL personnel to St. Louis is contemplated.

AVSCOM will be renamed to reflect its exclusive mission in the field of air mobility and will gain 56 personnel spaces from MSC in the area of aerial delivery.

The Engineer R&D Laboratories at Fort Belvoir are a field agency of MOCOM and are responsible for research, development and engineering for round-the-clock mobility in some 20 fields of military engineering, from bridges to night-vision devices.

Electronics Command Scientific Progress Reaches Broad Area

Discoveries which have made nations of the world only seconds apart by way of modern communication can be attributed immeasurably to pioneering research at the Army Electronics Command R&D Laboratories.

The Fort Monmouth (N.J.) installation is 45 years old, or young, depending on point of view, since history traces its origin to 1918 and Army leaders consider it in the full power of youthful vision and vigor.

Proponents of maintaining the strongest possible in-house laboratory capability to promote the best interests of Army research and development might look long, and in vain, for better proof of their contention than USAELRDL.

Presently under command of Maj Gen Frank W. Moorman, who assumed control shortly after USAELRDL marked the first full year as a major component of the U.S. Army Materiel Command, the Laboratories have a proud heritage.

"Who might have dreamed," mused one prideful scientist, "that from the mud-flat briar patch in New Jersey that started as Camp Little Silver would come marvels of electronics that literally have revolutionized world technology?"

Only a handful of Signal Corps officers, enlisted men and civilians staffed Camp Little Silver, now world-renowned as Fort Monmouth.

Over the years since that humble beginning, the Laboratories have experienced more than their share of vicissitudes, wartime expansion, postwar budgetary reductions and various adverstities to reach their current status as one of the Nation's top electronics centers.

More than 3,000 civilian and military employees now carry on the primary mission that has remained relatively constant in changing times—that of providing the Nation's Armed Forces with the finest communications and electronics equipment, theory and design concepts.

Major USAELRDL responsibilities are in the related fields of electronic communications and automation equipment, electronic surveillance devices, electronic warfare capability, and advanced meteorological methods.

Other USAELRDL investigative interests range through airline safety and fire protection automatic control devices, diminutive hearing aids, microminiaturized radios and radars, fuel cells as power sources, solar-powered batteries and other efforts to harness the power of the sun for science—in fact, almost countless products that benefit virtually everyone in the Nation, in or out of uniform.

Printed circuits, a step along the way that led to micromodule concepts in electronics to reduce size and weight of components, were developed by two USAELRDL engineers who were granted the basic patent on the technique.

Acclaimed throughout the world as one of the great technical advances in electronic equipment fabrication, printed circuits have saved many millions of dollars for manufacturers—savings passed on to consumers of transistor radios, computers, television sets, surveillance devices, and other products.

Used almost universally in production line radios, in most TV sets and in literally thousands of other civilian electronic items, printed circuits involve a relatively simple technique—and an imaginative idea. Holes are punched in a plastic board to receive conventional transistors, diodes, resistors, tubes, etc.

Connections are printed on the bottom of the board, the components are inserted, and the bottom is dipped in molten solder after all but the printed pattern is etched away. The solder adheres only to the printed lines and the component connections. The entire process takes seconds, as compared to hours needed for hand-wiring.

Primary patents on techniques of miniaturization of components of military electronic equipment cannot rightfully be claimed by USAELRDL scientists, engineers and designers, though they indisputably have been among forerunners in basic design, further innovation and refinements.

Credit for pioneering effort in the microminiaturization field is rated by a team of scientists at the Army's Harry Diamond Laboratories in Washington, D.C., formerly known as the Diamond Ordnance Fuze Laboratories. In 1959 five employees of DOFL—Dr. J. W. Lathrop, Norman J. Doctor, Thomas A. Prugh, James R. Nall and Mrs. Edith D. Olson—shared one of the three top $25,000 awards made since the Government Employees' Incentive Awards Program was established by Act of Congress in 1954.

Scientific progress as reflected in breakthroughs such as printed circuitry, microminiaturization, thin-film circuitry, and the spectacular comparatively new micromodule concept in electronics have such a profound impact throughout the world that even the wildest guessers would hesitate to gauge total value. Reason: Their greatest value may be in the future—in applications still to come.

Military requirements for the products of such dramatic scientific innovation are mounting, to use an oft-abused phrase conservatively, at an astronomical rate. Wars may be won, the future of nations decided, and the lives of untold millions dynamically affected by how well, and in what order, the advanced knowledge of electronics is applied.

Fully appreciative of these facts, the personnel who can rightfully claim even a small part of recognition for USAELRDL progress in advancing the Army's capability in electronics are understandably proud of the role they are playing.

Day-to-day developments are coming at either an astounding rate or far too slow to meet threats posed by supremacy of world powers in the field of electronics—again, all depending upon the point of view. Communications advances in recent years are accepted as long strides ahead but, in the opinion of many Army commanders, still inadequate for immediate and anticipated needs.

Take, for example, Lasers. Visionary thinkers see in Lasers perhaps the ultimate answer to communications—a slender beam of light that may carry a thousand or more channels of communication.

Lasers are serving also as range finders, for experimental surgery (an exploratory field as yet comparatively untouched), night vision, surveying, target detection, tracking devices—to mention only a few current applications, without any attempt to list anticipated uses.

In this vital field of effort, the Army's activities are centered at USAELRDL. Scientists there are recognized among world leaders in Laser research. Based upon achievements now a part of history but still a reservoir of knowledge for further progress, they may be expected to contribute much to the future.

Another area of research considered of tremendous potential application to military requirements, that of development of fuel cells as power sources, is centered at USAELRDL.

As envisoned by researchers, fuel cells could revolutionize generation of electrical power—could conceiv-

ably, when fully developed over possibly a decade or more, provide two or three times the total power output with the same amount of fuel as generation equipment now in use. Thus, they would conserve the Nation's fuel resources, as well as serve remote area or other specialized military power needs.

The Army is recognized as one of the early pioneers as well as being among current leaders in fuel cell research. Investigations are regarded as being of such potential importance to civilian as well as military requirements that nearly 50 major U.S. industrial firms are extensively engaged in the effort.

Importance of computers to countless civilian community requirements is universally recognized; importance to frontline combat requirements is much less widely known. But the U.S. Army has long been cognizant that the most effective use of computers may decide critical battles.

In that context, the work at USAELRDL on development of the Micropac computer is placed in proper perspective. Completely portable, Micropac is ruggedly built for operation under field conditions and requires less power than most computers now in general use. As a result of USAELRDL efforts, Micropac approaches the "desk top" computer ideal of commerce and industry.

Undergoing acceptance tests along with Micropac is the AN/MSQ–19, a command control center designed to combine modern electronics, data processing and display system to provide combat commanders with timely information on all aspects involving a command decision.

The control center concept would provide information to commanders on friendly and enemy strength, position of forces, logistics, air power and nuclear capabilities, all displayed on a single screen in command headquarters and revised continuingly.

Timely information about the weather is of virtually incalculable value to the civilian population throughout the world, with respect to crops, protection of homes against devastating natural forces, saving of lives, and areas of industrial concern.

Accurate weather forecasting is no less important to the combat commander. It may mean the difference between success or failure in military engagements. In providing the techniques and equipment for predicting weather conditions to meet planning requirements, USAELRDL scientists have long been recognized for superior competence.

Meteorologists at the Laboratories developed the first weather radar, an instrument that bounces signals off distant storms so accurately that thunder, snow and rain storm conditions can be predicted as far as 200 miles away. Continuing research is directed toward the goal of increasing the range, with equal reliability, to 400 miles or more.

Other meteorological research activities as USAELRDL have encompassed use of miniature balloon and rocket-borne instrumentation and radio sets that combine to transmit information on weather conditions in the upper atmosphere to specially designed ground stations. There the information is processed automatically to provide the basis for weather predictions.

Many of the information collecting techniques and instruments developed at USAELRDL have proved of vast benefit to the U.S. Weather Bureau and the other military services, leading to progressive improvements in methodology.

The basic patent on pulse radar, the principle now used in various sounding techniques, was granted to a former USAELRDL commander, Lt Col John D. DeWitt, Jr. Likewise, many of the tubes that made possible high frequency radar work and the use of a single set for both sending and receiving were invented and patented at the Laboratories.

The 200-mile radars used to make commercial flying more safe today are refinements of USAELRDL-developed radars for antiaircraft fire.

Ground controlled approach (GCA) techniques have saved countless lives since introduced about 17 years ago. Civilian and military aircraft can now approach airports with minimum fear of collision or ground crash because of GCA, even when weather conditions are extremely adverse. Without magnetron electronic tubes developed under USAELRDL auspices, GCA radars might not exist.

The world's first successful weather satellite, TIROS I, was developed under the technical supervision of USAELRDL scientists. Earlier they had contributed similarly to Vanguard II, the first attempt to record and transmit pictures of cloud cover and other conditions from satellites.

Subsequent TIROS satellites launched for the National Aeronautics and Space Administration stemmed from those early efforts. In reporting on heretofore unforeseeable weather conditions, including incipient hurricanes and tornadoes, the satellites have permitted observation of conditions as far out as 1,000 miles from ground stations.

Today, Telstar, Relay and Syncom satellites provide worldwide communications facilities undreamed of 20 years ago. All can properly be considered to have had their genesis in research knowledge accumulated by scientists and engineers at USAELRDL, long in advance of application.

(Continued on page 10)

USAERDAA Deputy Picked to Attend War College

Col Mitchel Goldenthal

Deputy Commander Col Mitchell Goldenthal of the U.S. Army Electronics R&D Activity (USAERDAA) at Fort Huachuca, Ariz., has been selected to attend the Army War College at Carlisle Barracks, Pa., this August.

A veteran of 25 years of Army service, with eight campaign stars to his credit in World War II and the Korean War, he was graduated from the United States Military Academy in 1943. He took part in the Normandy Beach D-Day landings in France and later served with the 90th Infantry Division in the Battle of the Bulge.

After the war he attended Texas A&M and was graduated with distinction and an M.S. degree in civil engineering in 1947. Tours in Europe and the U.S. preceded his assignment to Korea to command the 1903rd Engineer Aviation Battalion.

Col Goldenthal was awarded the Legion of Merit by the U.S. Air Force for his efforts in constructing one of the largest modern concrete Air bases in Korea. In his assignment with the USAREUR Construction Section at Headquarters, U.S. Army Europe, Heidelberg, Germany, he was awarded the Army Commendation Medal with Pendant.

Graduated from the Command and General Staff College at Fort Leavenworth, Kans., he returned there as an instructor following a year of duty as assistant chief of staff, G-3, at the Engineer Center, Fort Belvoir, Va.

Electronics Command Progress Reaches Broad Area

(Continued from page 9)

The first communications satellite was SCORE, which in December 1958 proved the feasibility of communications by way of an orbiting satellite when it relayed President Eisenhower's Christmas message to the world.

In September 1960, the Department of Defense assigned the Army responsibility for development of two communications satellites. The first, COURIER, carried the President's message to the United Nations via space, as was reported in the December 1960 introductory issue of this publication ("The Army's New Role in Space Communications"). Later came another triumph, ADVENT.

TIROS is an acronym for Television and Infrafred Observation Satellite. While the infrared portion of TIROS was never developed fully, the USAELRDL concept has interesting offshoots with civilian benefits.

One of the most recent, concluded this fall, was Operation Firescan. This was an experiment in the Northwestern United States that proved the feasibility of using infrared heat-detecting equipment in aircraft to locate forest fires in their early development for prompt control measures.

Still another USAELRDL development of worldwide significance, accepted today by civilians as a commonplace fact of everyday life, is long-range radio relay. Military radio communications requirements led to this technique.

Unattended radio relay stations now save millions of dollars annually in manpower and equipment costs by forwarding normal long-distance telephone calls without any manual control. They also make possible coast-to-coast live television.

Battery power sources are a basic military requirement for vehicles, forward area combat communication equipment, and many other uses. In this area of research also, the USAELRDL scientists and engineers are known for outstanding achievements.

Due substantially to knowledge discovered at Fort Monmouth, the ordinary dry cell, such as used in a flashlight, lasts about five times as long and costs about the same as it did before World War II.

Solar-powered and other highly specialized batteries developed at USAELRDL have been keyed to space exploration communication needs. Current research on zinc silver ozide batteries as well as mercury and nuclear cells, aimed at military applications, holds promise of many civilian applications.

Scientific progress that enables the Army to make better use of the tax dollar is a constant objective at USAELRDL. A notable recent example, which won a 5-man research team one of the top honors at the 1963 Secretary of the Army Awards ceremony in Washington, D.C., is the "electronic crowbar," an ingenious device that has saved the Government about $2 million on Nike Zeus anti-missile missile system tests to date.

A complete report on USAELRDL activities which yielded byproduct benefits for the civilian population would more than fill the space allotted for the anniversary edition of the *Army R&D Newsmagazine.* In working to maintain American military pre-eminence, USAELRDL personnel are continuingly aware of their opportunity to serve public interests.

Solar System Encyclopedia Cites Army Physicist

A new 5-volume encyclopedia, *The Solar System,* cites a U.S. Army physicist as a foremost authority on the theory of using moon-reflected radar signals for scientific research.

Dr. Fred B. Daniels, an employee of the U.S. Army Electronics R&D Laboratories (USAELRDL) at Fort Monmouth, N.J., is acclaimed in the fourth volume, entitled "The Moon, Meteorites, and Comets." His theoretical work with moon radar is described as the "most extensive treatment" ever given the subject. The volume was edited by Barbara Middlehurst and Gerard P. Kuiper.

As a member of USAELRDL's Institute of Exploratory Research, Dr. Daniels has been using Diana, the first radar to record an echo bounced off the surface of the moon, in his radar reflections research. (See November issue, p. 11, for feature article on Diana.)

Through his analysis of reflected moon signals and his work on the electron density of the ionosphere, he has not only assisted in improving radio communications, but has also succeeded in analyzing the fine-scale features of parts of lunar landscape.

Since such information on average surface roughness is beyond the resolution of the largest optical telescope, the work is viewed as being highly significant as a means of learning more about the moon.

Dr. Daniels, who has worked for the Labs since 1940, obtained a B.A. degree (1933) and an M.A. (1934) from the University of Nebraska. He received his doctorate (1938) from the University of Texas.

He is a member of Phi Beta Kappa, Sigma Xi, and Pi Mu Epsilon, and belongs to the American Geophysical Union, the International Scientific Radio Union, the Acoustical Society of America, and the Institute of Electrical and Electronics Engineers.

He holds a Meritorious Civilian Service Award from the Department of the Army, has been granted several patents and has published more than 20 papers in leading journals.

The encyclopedia is being published by the University of Chicago Press.

Dr. Fred B. Daniels

Redstone Engineer Named To Deputy Director Post

Waite H. Todd, an engineer with seven years experience in the Army Missile Command's Directorate of Research and Development, has been named deputy director of the Electromagnetic Laboratory, Redstone Arsenal, Ala.

Until his appointment, Todd was chief of the Laboratory's Radiation Branch. He was promoted after William E. Yoakum, the former deputy director, resigned to accept a position with private industry. He came to the Arsenal in 1951 and in 1955 received his master's degree in electrical engineering from Auburn University, where he also earned a bachelor's degree.

In 1956 he joined the staff of the Directorate's Physical Sciences Laboratory as a guidance and control electronics scientist. Three years later he joined the Electromagnetics Laboratory where he headed a group for setting up an electromagnetic emission research facility.

A native of Trussville, Ala., the 36-year-old scientist is a member of the Institute of Electrical and Electronic Engineers and of Tau Beta Pi and Eta Kappa Nu fraternities.

Canadian Army R&D Objectives Linked to Quadripartite Effort

Research and development activities in the Canadian Army are influenced strongly by standardization objectives. The Canadian Army effort is directed towards standardization with other signatory countries of the Quadripartite Agreement (United States, United Kingdom, Australia) as well as with the Royal Canadian Navy and Royal Canadian Air Force.

Integration with sister services has provided momentum to the Canadian Army's progress in standardization within the Department of National Defence. A few examples will provide a frame of reference for the Canadian Army perspective.

Dental support for all three services is the mission of the Director General of Dental Services, Canadian Army. The Canadian Army Director of Armed Forces Postal Services supports sailors and airmen. The Surgeon General tri-service organization supports the three services.

Similarly, the Department of National Defence performs inspection services for the three services through a large defense department organization titled simply, Inspection Services. Several joint agencies and bureaus perform a wide range of logistical, administrative and training functions.

Two organizations have key roles in the research and development program of the Department of National Defence (DND). The Defence Research Board, a DND agency, controls or executes all research for the three services. The Directorate of Inter-Service Development (DID) is responsible for the design, engineering and development of clothing and general stores required by RCN, Canadian Army, and RCAF. The Directorate is administered by the Deputy Quartermaster General, Equipment Engineering, Army.

The DID includes officers of the three services. Its development programs are received from a joint steering committee but general and financial administration is an Army responsibility. The Director and two deputy directors are officers from the three services, and the position of director is rotated. One U.S. Army Standardization Representative is attached to the directorate.

The present director is Col B. W. Mellor. Prior to appointment, he was Canadian Member, Primary Standardization Office, Office of the Chief of Research and Development, U.S. Army. He controls his own laboratory facilities and has full advantage of Canadian Government facilities.

Canadian Army Directorate of Inter-Service Development leaders shown (left to right) are Col B. W. Mellor, director; Lt Col R. Hodgdon, U.S. Army representative; Wing Commander T. H. Fletcher, RCAF, deputy director, Administration; Commander H. R. Beck, RCN, deputy technical director.

In designing and engineering materiel standardized for the three services, the Canadian Army's Directorate of Inter-Service Development can point to a wide range of corollarial accomplishments in the promulgation of tri-service specifications, reduction of line items, reductions in weight and critical materials, and lowered procurement costs.

Additionally, DID developments have also resulted in standardizations with the United States and the United Kingdom. Potentiality of an item for standardization with the Quadripartite countries is a basic consideration in most DID projects. The Director, DID, will normally act as leader of any Canadian delegation to Commonwealth or Quadripartite Conferences on clothing, textiles, footwear and general stores.

The U.S. Army's R&D interest in DID development projects extends to a wide range of items. Oriented as Canada is toward the North, DID activity in Arctic clothing and equipment is closely observed.

A creative independence reflected in a willingness to move in new directions, and to search for new concepts, holds forth the promise that the Canadian Army's Directorate of Inter-Service Development may exert an influence in Quadripartite development beyond the expectations of its modest budget.

Quadripartite Meeting Clarifies Program Priorities

Weapons development cooperative effort objectives were clarified within a specific time frame at the second meeting of the Quadripartite Ad Hoc Working Group on Priority Standardization Effort in Washington, D.C., Nov. 12-15.

The meeting was held at the Industrial College of the Armed Forces, Fort Lesley J. McNair, with Deputy Chief of Research and Development Maj Gen George W. Power, U.S. Army, presiding as chairman.

Discussions on R&D projects and areas of collaboration were held under the auspices of the American-British-Canadian-Australian (ABCA) Standardization Program. The purpose was to review progress on projects and to consider new proposals for recommendations on priority standardization goals.

A considerable number of "worthwhile projects" were proposed for the Priority Standardization List (PSL). Before action can be taken to effect collaboration in the recommended areas, however, each of the ABCA Armies will review the proposals.

Maj Gen A. P. W. Hope, Director of Equipment Policy, British War Office, headed the UK delegation. The Canadian Army group was headed by Brigadier D. A. G. Waldock, Deputy Quartermaster General (Equipment Engineering). Col R. K. Roseblade, Director of Weapons Policy at Australian Army Headquarters, led the Australian group.

ABCA standardization officers stationed in Washington, D.C., also took part in the meeting, namely: Maj Gen R. E. T. St. John, United Kingdom; Brigadier J. A. W. Bennett, Canada; Col E. J. H. Howard, Australia; and Col N. T. Norris, chief of the International Division, Office of the Chief of Research and Development, Department of the Army, United States.

20 Questions on Nation's R&D Program Asked In Report on Congressional Committee Inquiry

Twenty questions probing complexities of the Government research and development program, currently costing about $15 billion a year, are asked but not answered in a report on Congressional inquiry into needed action.

Hearings of the House Subcommittee on Science, Research and Development headed by Representative Emilo Q. Daddario (D. Conn.), in recent weeks have searched penetratingly into R&D activities, future plans and levels of effort in precise research areas. The subcommittee operates under the House Science and Astronautics Committee.

Information desired by the subcommittee, for example, has reached down to the division chiefs level of many Defense and other Government agencies. Director of Army Research Walter E. Lotz and members of his staff spent many hours explaining in detail the scope of research programs.

Top leaders in the Nation's scientific effort, including Dr. Jerome B. Wiesner, director, Office of Science and Technology and chief scientific adviser to the President, made a long presentation on scientific problems.

Congress is concerned with the single big question of management of the Nation's R&D effort—how to control and adequately direct the increasing expenditures for scientific research. The subcommittee report states, in part:

"Scientists and industrialists who criticize Government policies, therefore, may turn to Congress to seek a review or a different judgment. In such cases they often contend that there is no room for dissent in the executive process which results in major decisions— a complaint not unheard in other countries where Government-sponsored research is on the ascendancy."

The report also discusses the much-debated question of Government funding of so-called basic research in educational institutions and either hoping or expecting that it will result in "some identifiable, practical benefit which . . . can be justified to budget controllers in both the Executive and the Legislative branch."

Cited in the report is a statement made in Dr. Wiesner's presentation:

"The Government must insure that its sponsorship of science does not corrupt the educational process by distorting its values and objectives."

In support of that position, the report refers to the frequent claim that graduate students and faculty members, because of Government-sponsored activities, are attracted to the more glamorous research programs, to the detriment of other "important areas of inquiry."

Many of the 20 questions raised by the subcommittee report are similar to those Army R&D leaders have considered at length in recent months. Among questions in the report are:

- Is the organization of scientific research and development within the Federal Government adequate to guarantee full use of our resources?
- Is the opinion and knowledge of the scientific community adequately brought to bear in the decision-making process of the Federal Government, both in scientific matters and in public policy?
- What level of basic research should the country and the Federal Government support to assure the maintenance of leadership in the world?
- What important areas of science are being neglected?
- What areas of science suffer from a manpower shortage?

Service R&D Chiefs Stress Fully Coordinated Efforts In Series of Discussions

(Continued from page 1)

Col Edward Duda, assistant deputy in the Directorate of Plans and Programs, is the representative of the Office of the Chief of Research and Development on the Ad Hoc Committee, which is functioning as a steering group. Col C. J. Butcher is the Air Force member and Capt H. H. Ward represents the Navy.

One of the joint proposals is that the Services will require that forms initiating new materiel requirements and projects will include statements that similar work in each Service has been checked, and that the project officer is aware of other efforts in the project area.

Lt Gen Dick has indicated that he desires all project officers to study line items and the extent of coordination of projects to date with the other Services to seek areas of improvement. "Mutual cooperation" in R&D with the other Services is to be basic to the concept of operations.

The Ad Hoc Committee will prepare a preliminary list of areas of mutual interest wherein consolidation or coordination of efforts may be achieved. In the continuing discussions these subjects will be examined in detail to consider how effcient R&D cooperation can be attained.

One of the problems that will be vigorously approached in the Tri-Service Cooperation Program is the "duplication and proliferation of R&D projects"—particularly where it appears to stem from "pet hobbyshop" practices and the rational that each Service must have independent capability to pursue R&D in all areas deemed necessary to support its missions because of "Service-peculiar requirements."

$20 Billion Outlay Seen For Nation's R&D in 1964

Research and development expenditures in the United States will attain an all-time record high of about $20 billion in 1964, as compared to an estimated total of $18.3 billion in 1963 and $16.6 billion in 1962.

Those figures come from economists at Battelle Memorial Institute, Columbus, Ohio. They predict that in 1964 the Government will spend about $13.9 billion for R&D, industry about $5.6 billion, academic and nonprofit institutions about $500 million.

Dr. George W. James and Granville H. Sewell compiled their estimates on the trend of R&D growth. In their opinion, about $1.1 billion will represent the increase in Government R&D spending, despite "rising pressures from Washington for more austerity in many research programs."

The growing recognition among industrial leaders that research is "an investment in the future" is used by the economists to explain an estimated increase of about $550 million for research in 1964. That would double the increase noted between 1962 and 1963.

Abnormal developments, the economists anticipate, could result in a more substantial increase in industrial R&D expenditures, that is, about $6.4 billion as viewed against their estimate of $5.6 billion, the latter figure admittedly being considered "conservative."

A limiting factor in the desire of both Government and industry to expand research effort, it was stated, is the number of qualified research scientists available. This fact is expected to keep growth at a modest rate.

Picatinny Arsenal Reports on Thermo-Analysis Work

Crime detection and materials research may not evidence any simple relationship, at least to the uninitiated, but advanced thermo-analytical experimental techniques developed at Picatinny Arsenal apply to both.

The Basic Research Unit of the Pyrotechnics Laboratory at the Army installation at Dover, N.J., has been among the pioneers in developing methods of measuring the physical and chemical changes that take place when materials are heated to high degrees.

Differential thermo-analysis and theomo-gravimetry techniques have been applied to numerous military requirements, and have proved equally useful for many products of civilian life ranging from cosmetics to jet aircraft.

Picatinny Arsenal scientists have demonstrated that their methodology identifies materials accurately enough to "finger print" the fabric in a criminal's coat and to tell, from the soil on his shoes, the approximate location of a crime.

The same techniques can "finger print" materials in a cosmetic as easily as in an explosive, and can characterize the structure and the chemical bond which links them.

Among familiar products on which the analytic techniques are used extensively by industry are fireproof fabrics, textiles, rubber, ceramics, pharmaceuticals, radar and aircraft materials, wood pulp paints and coatings—to list only a few.

Scientists use thermo-analytical techniques in biochemistry studies of oxidation of metals and decomposition reactions of oxidants and polymers, preignition and ignition reactions between fuels and oxidants, and effects of nuclear radiation on the reactivity of oxidants and fuels.

Development of thermo-analytical techniques has been in process for a number of years at Picatinny Arsenal, and the Basic Research Unit of the Pyrotechnics Laboratory has gained broad recognition for significant advances.

Dr. Eli Freeman, director of the Basic Research Unit, Pyrotechnics Lab, examines new design draft with David Anderson and Clement Campbell, members of Picatinny research team.

Thermionic Converter Seen As Having Broad Potential

A thermionic converter used at Picatinny Arsenal as a power source, developed by the Nuclear Engineering Directorate at the Arsenal, is envisioned as serving civilian needs.

Arsenal engineers and scientists anticipate that the device, which has no moving parts, will be able to convert thermal energy directly into electrical energy for many purposes, such as an emergency power source in homes.

Experiments have shown that the device can function as an emergency light-duty power source by use of replaceable heat charges, inserted one at a time in the convertor. This could be valuable when conventional power sources are temporarily disrupted by storm conditions.

Car owners also may be able to use the converter as a replacement for generators and alternators. Experiments have shown that the device can be placed between the exhaust manifold and the engine block to change the waste heat of the engine into electrical power.

Wide use of the thermionic converter also is envisioned as a source of power for missiles and rockets, and for warheads and satellites.

What Type of Engineers Are Needed in R&D Labs

(Continued from page 2)

must be made on the basis of our knowledge, reinforced by the knowledge of others equally objective.

In our relationship with the commercial world we must be in a position to truly control our missile business. We must have technically competent people in our laboratories who have no conflicting interests and who, therefore, can afford to be objective.

A third necessity for an engineer in the R&D laboratories is that he be technically competent and have a full measure of objectivity.

There are those who believe that reliable missile systems can be provided to the user without Government competence in in-house R&D laboratories. This belief ignores some very basic principles.

Primarily, it is only good business management to maintain controls on industry engaged in missile system engineering. To apply this control, a capability to control is required, not just by suggestion but by direction when necessary.

Second is the capability to control requiring knowledge and experience. Without this experience, one must rely on faith and hopeful trust. The engineer cannot know whether his faith is well placed unless he has first-hand knowledge.

Engineering and scientific knowledge deteriorates in a vacuum. Unless the engineer has the responsibility for actual hardware work, for getting his hands dirty, he will become the kind of engineer who looks over drawings and hopes he is right, but has a measure of doubt as to his wisdom, since he is not current with the state-of-the-art.

My fourth premise is that the engineer in the R&D laboratories must have confidence in his own knowledge. This knowledge must come from working with the hardware, not just sitting in a staff position and waiting for a problem to be posed.

In order to provide the scientists and statisticians with first-hand knowledge, some of our business must be done in-house; enough to allow us to control the rest of our missile business. I have heard that a good many years ago when Henry Ford started to build a small steel plant, a committee from Congress questioned him about monopoly.

"Isn't there enough steel in the country for you," he was asked. "Yes Sir," Ford answered. "Well then," the committee asked, "why do you build a steel plant?" Henry Ford's answer is said to have been—"Gentlemen, to learn enough about making steel to know what I'm buying from the steelmakers."

My final premise is that we require engineers in the R&D laboratories as key members of the team to help us remain leaders in missiles, so we can influence what we are buying from the missile makers.

U.S. Army Nuclear Power Program: Impact on Tomorrow

By Col Robert B. Burlin

Scientists were aware of the potential capability of nuclear energy as a source of domestic heat and electrical power even before World War II. Not until the war had been successfully terminated, however, could this awareness become a coordinated development program.

Even then, military nuclear development took other routes dictated by "cold war" needs before full attention could be given to the utilization of atomic resources for the production of electricity and space heating.

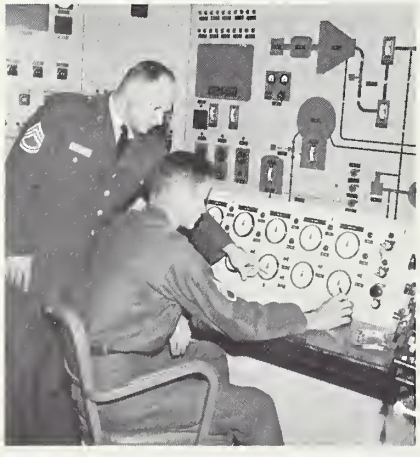
The military nuclear power development program began in 1952 as a study assigned to the Chief of Engineers, Department of the Army. This was a natural assignment choice. Development of the atomic bomb had been carried out through the famous Manhattan Project, named for the Corps of Engineers District which had administered it.

In the years between the Manhattan Project and the initiation of the nuclear power study, the national atomic development effort had been centralized by Congress in the U.S. Atomic Energy Commission. A considerable research and development effort, which included submarine and marine surface propulsion devices as well as civilian nuclear power, already was in progress.

Military feasibility of nuclear power was determined by a Corps of Engineers study, and the Secretary of Defense designated the Army responsible for a development program to be carried out in association with the Atomic Energy Commission.

World War II and the ensuing period of "cold war" provided the problems and the needs which justified military interest in nuclear power. Because of Free World defense commitments, United States military forces were spread on a global perimeter. The accelerated mechanization of our forces, in conjunction with the need to provide heat and electricity at far-flung installations, created a continually increasing fuel supply burden.

ML-1 Nuclear Power Plant in transit.



Student operator receives instruction at control console of nuclear power plant simulator at Fort Belvoir, Va.

During World War II, fuel supply commanded roughly half our overseas logistic load. The proportion increased to an estimated 70 percent in the Korean War. Nuclear power offered the best possible solution to this problem. Nuclear fuel cores could sustain power production for periods exceeding a year.

The Army Nuclear Power Program, an association of Department of Defense and Atomic Energy Commission activities, is responsible for developing nuclear power plants capable of supporting land operations of Military Services.

Although its mission is military in character, the Program complements the national reactor development effort oriented to civil applications. It has been a leader in developing reactor core technology and in accumulating operating knowledge for the entire industry.

The technologies of civilian and military programs are interrelated, both feeding into the national body of atomic knowledge. In detailing the projects of the Army program, I hope to indicate further its relationship to the civil community.

Our initial military nuclear power plant, the SM-1 at Fort Belvoir, Va., was the first reactor facility in the United States to supply power to an electrical grid. This 2,000-kilowatt facility began operation in April 1957, several months before a 60,000-kilowatt commercial plant was erected for the Duquesne Light Co. at Shippingport, Pa. The SM-1 is used now primarily for training nuclear power plant operators.

One illustration of the close relationship between our military program and the civilian effort can be found in our operator training program, an intensive one-year course of technical study. Rigid criteria form the basis for selection of the men who attend this specialized course. Graduates are men of outstanding traits and abilities in the areas of mechanical, electrical, instrument and process control maintenance.

In addition to military plant operators, we are training civilians who will be employed at the Army's SM-1A Nuclear Power Plant at Fort Greely, Alaska. Our enlisted technicians may later, as civilians, enter the commercial markets as fully skilled manpower.

As a result of the success of our Program, we are participating with the Atomic Energy Commission in a study to develop operator training criteria applicable to the entire area.

Specific military requirements led to further modification of the technology used in developing the SM-1 to produce a packaged, air-transportable category of plants designed for utilization at remote, relatively inaccessible military bases. The first was installed late in 1960 in snow tunnels at Camp Century on the Greenland Icecap.

Designated the PM-2A, this 1,500-kw. plant was fabricated in 27 modules and test-erected in the United States prior to shipment to Green-

land. At Camp Century, where climatic conditions limit the construction season and make resupply difficult, the PM-2A was reassembled in just 78 days. Since initial criticality in February 1961, operation of the plant was sustained by a single nuclear fuel core until it was shut down in July 1963. The plant will be moved to a new operating site, probably outside Greenland, beginning in the spring of 1964.

Plants similar to the PM-2A, but of improved design, have been installed subsequently at military bases in Wyoming and Antarctica. The Wyoming plant provides heat and electricity for an Air Force radar station. The Antarctic plant supports an extensive scientific mission at the Navy's McMurdo Sound installation.

The Army Nuclear Power Program effort in station facilities, representing the low-power end of the civilian-military spectrum of plant construction, has assumed leadership of the small reactor industry.

Design of a standardized 1,500-kw. portable plant will be completed early in 1964. Recently the Army began development of an advanced, second-generation type of portable 1,000-kw. military plant. The objectives of this latter effort include significantly reduced installation and operation costs, easier installation and reduced size.

Portable nuclear power plants can serve the civil community in many areas—as independent power facilities in the development of remote, isolated areas, for the desalinization of sea water in areas where fresh water is unavailable, for mining operations in undeveloped areas, etc. The Army program in second-generation nuclear powers plant development may hasten civilian applications.

Civilian plants, with outputs as high as 210,000 kw., are in operation at various locations in the United States. Plants capable of more than twice this output are being planned.

Although the economics of smaller nuclear power plants characteristic of military station requirements are not as favorable as larger civilian plants, the logistic and operational advantages provide additional justification for installing nuclear power at military bases.

In our military program, concentrated effort also is directed to development of mobile nuclear power plants. In this area, the Army has pioneered in gas-turbine technology applicable to civilian industry far beyond the field of nuclear power.

The Program in 1959 began operation of the Gas Turbine Test Facility at Fort Belvoir, an installation which has become the Advanced Power Conversion Experimental Facility.

Mobile plants, to be practical for military purposes on land, must be of considerably reduced size and weight in comparison with station plants. These requirements could be met only through technologies in which relatively little development has begun.

The first plant to be developed in this area, the ML-1, initially produced electricity in September 1962 at the National Reactor Testing Station in Idaho. The 300-kw. ML-1 is the world's first direct, closed-cycle, gas-cooled reactor facility. It is the prototype of a nuclear power plant class designed to be trailer-mounted for field Army use.

Plants of this type, capable of generating between 300 and 500 kilowatts of electricity, will provide power for semimobile units such as command and communications centers, major field headquarters, computorized tracking and firing facilities, field hospitals, etc. They also can provide emergency power for devastated areas. Such plants will operate for 10,000 hours on a single loading of nuclear fuel.

Recognizing that greater blocks of power will be needed in mobile applications, the Army has begun development of plants capable of producing between 2,000 and 3,000 kilowatts. This larger mobile plant, which requires refueling at 2-year intervals, has been designated the Military Compact Reactor.

The largest plant undertaken by the Program to date is the MH-1A, a 10,000-kw. barge-mounted facility intended to support military operations on land adjacent to navigable water. Construction of the MH-1A began in January 1963. Mounted in the modified hull of a Liberty Ship requisitioned from the "Mothball Fleet," the MH-1A eventually will be assigned to Strategic Army forces.

Mobile nuclear power plants, while oriented toward military field requirements, nonetheless offer distinct possibilities for civil requirements for supplementary power in disaster relief situations. In the closing months of World War II and the following reconstruction period, barge-mounted diesel power plants did yeoman service at devastated European port cities.

A similar floating plant, constructed at Jacksonville, Fla., was newly completed when hurricane winds destroyed the city power supply. This plant sustained the city's essential electrical needs for almost a year while the conventional power system was being restored. Both sea- and land-mobile nuclear power plants could serve in similar emergencies.

Mobile nuclear power plants, in particular the Military Compact Reactor and the barge-mounted facility, are expected to yield their greatest value as primary energy sources for

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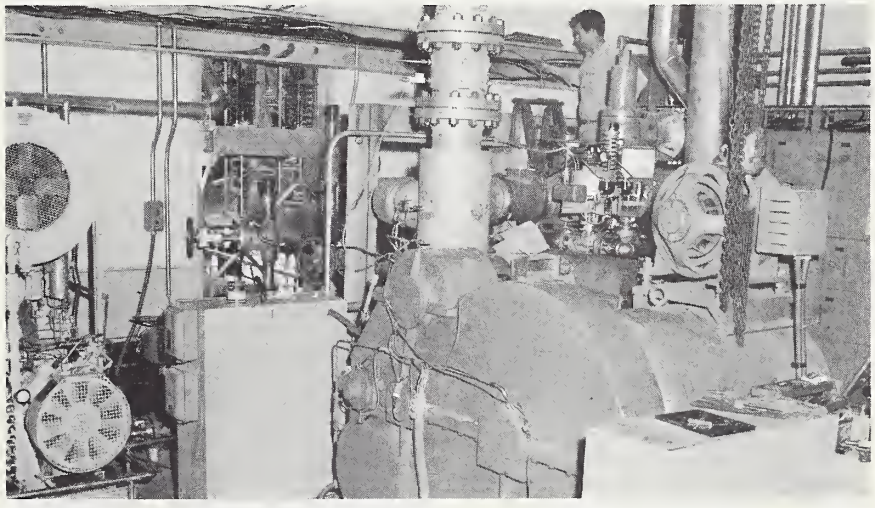


Machinery room of experimental facility for testing and developing power conversion equipment for 500 kw. (e) mobile, gas-cooled, closed-cycle, nuclear power plant. The facility includes high-speed, gas-cooled, closed-cycle turbo compressor unit, reduction gearing, recuperator (regenerative heat exchanger), generator and transfer compressor system, as shown. Located outside the building are a high-temperature heater, precooler, emergency power unit and load bank. Experiments will be conducted with turbo-machinery up to 18,000 r.p.m. and modification will permit operation as high as 30,000 r.p.m. at higher temperatures using gas-lubricated bearings. The experimental power producing facility became the first in the U.S. to operate in a self-run condition, and is believed the first of its size in the world.

a Nuclear Powered Energy Depot system, the ultimate objective of the Army Nuclear Power Program.

Essentially a means by which nuclear energy can be applied to the field Army's vehicular fuel problem, this conceptual system would utilize a mobile nuclear power plant to produce vehicular fuel near the point of consumption in a military theater of operations. (The Energy Depot concept is dicussed on page 20.)

The feasibility of the concept has been determined in a variety of possible applications. We might employ such a system to 1) produce an entirely new fuel, 2) upgrade the energy content of present fuels, or 3) regenerate or reconstitute expended fuels for re-use. In any of these examples, the Depot would make use of the universally available raw materials, air and water; hence its added advantage in a combat theater.

Developments in this last area of Army Nuclear Power Program interest may well lead, in the distant future, to some utilization of the concept in the civil community—especially were the current sources of vehicular fuels denied or were production to reach an uneconomic point through depletion.

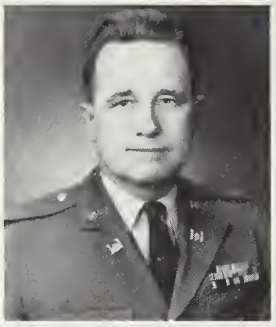
The civil community then quite possibly could look to the Energy Depot as a single source of electricity for light, machinery, heat, water and transportation. The prime energy sources of these civil Energy Depots could be either extensive hydroelectric developments or large nuclear power plants.

Through extensive utilization of Energy Depot systems, the community environment might also benefit from the elimination of fumes and soot and the reduction of smog. Remaining fossil fuel materials could be conserved for the manufacture of other products valuable to society.

The Army Program also provides technical support for military research reactors which are used for experimental purposes in the areas of medicine, food preservation, construction engineering, etc., all of which are applicable to civilian requirements. Studies also are underway for the National Aeronautics and Space Administration with regard to nuclear powered lunar bases.

Military research and development efforts such as the Army Nuclear Power Program ultimately enrich the civilian environment at a quicker rate of progress than would occur through normal enterprise.

Looking at the example of modern air transportation in comparison with the crude flying machines of the 1930's, one cannot help wonder how far aerodynamics would have progressed without the impetus of defense requirements. Our military nuclear power program today is even younger than was the air industry of the 1930s. Benefits it promises the civil community tomorrow are unlimited.



Col Robert B. Burlin

Col Robert B. Burlin has served as director of the U.S. Army Nuclear Power Program since October 1962, following service from 1960 as chief, Army Nuclear Power Field Office at Fort Belvoir, Va.

Graduated from the United States Military Academy in 1943, he served during World War II at the CBI Theater on road and airfield construction until assigned in 1945 to Peiping, China with the Marshall Plan group.

After graduating from Massachusetts Institute of Technology with a master's degree in civil engineering, he attended the Army Engineer School at Fort Belvoir, and in 1955 completed the Command and General Staff School course at Fort Leavenworth, Kans. His military record includes service from 1951-54 as commander of the 317th Combat Battalion, U.S. Seventh Army, in Germany.

Aberdeen D&P Services Link Oils, Fuels, Motors

"Marriage" of oils and fuels to motors on the basis of compatibility as predetermined by testing of characteristics is one of the functions of Development and Proof Services at Aberdeen Proving Ground, Md.

James C. Emanuel, a project engineer, reported on techniques employed in his Materials and Components Section as a recent speaker at a series of technical presentations. He said tests to gauge how well an engine, an oil, and a fuel "can coexist in harmony" are important to reliability of military materiel.

"The engine makes the decision in these tests," he explained. "If it can run on the particular fuel-oil combination without incurring unusual wear or deposit problems destructive to it, we conclude that the three elements are compatible.

D&P Services engineers James Emanuel (left) and Dale Woomert discuss oil compatibility test results during Aberdeen P.G. presentation.

"If there are problems, we must decide which element is to blame. It could be engine design — improper clearances; it could be oil formulation—too little detergent; or fuel refinement—too much sulphur."

Compatibility tests, he said, are not acceptance tests, endurance tests, performance tests or even development tests. Sometimes when an engine has demonstrated satisfactory performance, it will undergo additional tests to find out how well it performs on marginal fuels and lubricants. When a compatibility problem develops, modifying the oil usually solves it.

"Oils used in modern automotive engines perform several functions besides lubrication," Mr. Emanuel said. "They must also seal combustion pressures, cool and clean critical areas, and they must protect the engine from rust and other forms of corrosion—under conditions of temperature and pressure so severe that lubricants used 20 years ago could not possibly survive."

Though lubricants can be tailored to suit almost any application, the task is complicated by the fact that some additives lose their effectiveness when combined with others. Others have bad effects or cost too much.

"It is much more economical and easier to seek out problems deliberately, then isolate and resolve them under controlled laboratory conditions," he explained, "than it would be to attempt modification based on sketchy information from the field."

Deceased Army Scientist Acclaimed for Final Book on Research During IGY

Friends in many nations who mourned Dr. Carl R. Eklund's death on Nov. 3, 1962, may be interested in his final book, just off the press, *Antarctica: Polar Research and Discovery During the International Geophysical Year.*

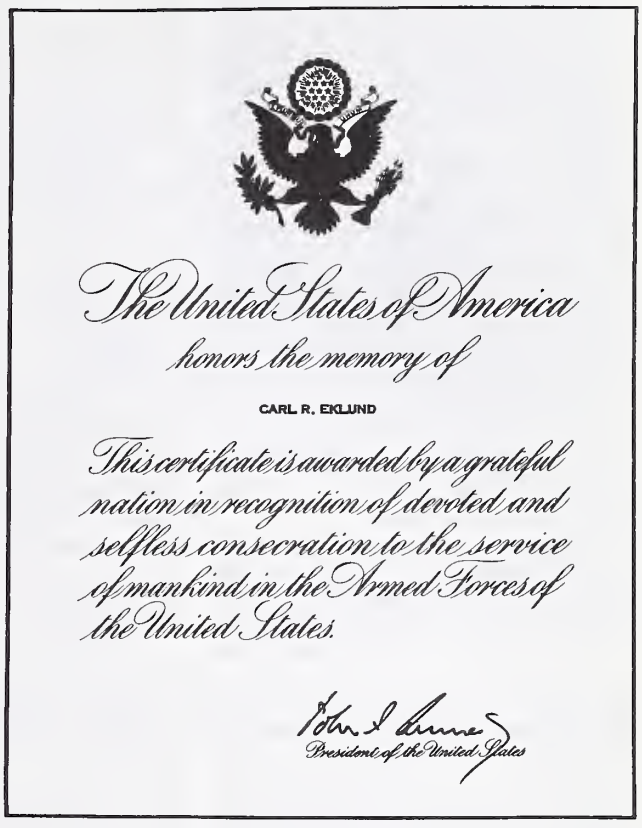
Coauthored with Joan Beckman of Washington, D.C., the book presents a vivid insight into the significance of south polar research, in which the U.S. Army historically has taken a leading role. Dr. Eklund, chief of the Polar and Arctic Branch, U.S. Army Research Office, at the time of his death, was scientific leader at Wilkes Station in Antarctica during the IGY.

Director of the U.S. IGY Antarctic Program Laurence M. Gould, president of the American Association for the Advancement of Science and president emeritus of Carleton College (Minn.) states in a foreward to *Antarctica:*

". . . Having been associated with Carl Eklund over so many years, I cannot write even the briefest foreward without commenting on my personal debt to him. He was not only resourceful in experimentation but was bold in his imagination. Those of us who helped plan scientific programs with him were stimulated by his thinking and cheered by his wit. We shall not see his like again soon.

"The book is not only a first-rate account of our present scientific knowledge of Antarctica, but also much more. Here the real significance of present and future Antarctic research in relation to the world of science is clearly set forth. Here it is made clear that there is no major field of geophysics which does not need information derived from Antarctica. . . .

"If I could place but one book in the hands of any reader, old or young, who has a real concern to know about Antarctica, it would be this book by Carl Eklund and Joan Beckman. It is a veritable handbook, a mine of information, and I predict it will persuade many youthful readers, at least to want to followin Carl's footsteps."



Another fine tribute to Dr. Eklund as a scientist and as a man who "was a joy to know because of his sparkling humor and warm human qualities" is contained in a preface to *Antarctica* by Dr. Paul A. Siple.

Renowned as one of the world's foremost polar explorers and scientists, Dr. Siple is on a 2-year leave of absence from the U.S. Army Research Office as scientific adviser, serving as Scientific Attache to Australia and New Zealand for the State Department. His tribute states:

". . . As biological specialist on the National Academy of Science's Polar Committee, he had important impact on the polar programs being carried out in Australia. As the first president of the Antarctican Society of Washington, D.C., he was in intimate contact with scientists and explorers currently working in Antarctica.

"Perhaps no single person has had more knowledge than he of the emerging new scientific facts about Antarctica—especially of its biological aspects."

Published by Holt, Rinehard and Winston, Inc., in the Holt Library of Science Series, *Antarctica* touches briefly on the history of antarctic research, describes the animal life, reviews planning for U.S. research in the IGY, traces efforts in various areas of science, and dwells on possibilities of future exploration and research in the region.

Monolayer Polymers Promise Corrosion Protection

Findings in an Army contract research project titled "Monolayer Polymers for Corrosion Protection," reported by the U.S. Army Research Office, Durham, N.C., are regarded as meriting further investigation by various Army laboratories to utilize advantages.

Paul S. Greer, associate director of the Chemistry Division at the Durham office, in a letter dated Dec. 17, informed the U.S. Army Research Office Headquarters in Washington and the Army Materiel Command of the completion of the project study. The final report is in process.

Contract work was done by Dr. Norman Hackerman and Robert R. Annand of Texas Research Associates in Austin, Tex. Status reports claim that poly (4-vinylpyridine) and poly (4-vinylperidine) have exhibited corrosion inhibiting properties "many times superior to the corresponding monomeric inhibitors (4-ethylpyridine and 4-thylpiperidine)."

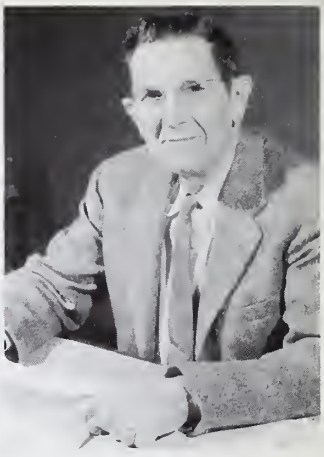
Qualities of the new inhibitor have been demonstrated with steel in aqueous hydrochloric acid solutions, and in aerated neutral sodium chloride solutions. The polymer employed is of comparatively low molecular weight (approximately 400) and is soluble in the test solutions.

Preliminary finds support the belief that the inhibitor might be useful in coolants for internal combustion engines, pickling solutions, hydraulic fluid, and in protective coatings.

Rock Island Arsenal is exercising primary scientific liaison for the project. Status reports have been submitted to the Chemical and Coating Laboratory at Aberdeen Proving Ground, Md., and Watertown (Mass.) Arsenal.

Dr. Langer to Retire as MRC Head in 1964 at 70

Dr. B. Rosser



Dr. R. E. Langer

Mandatory retirement at the age of 70 will come in June 1964 for Dr. Rudolph E. Langer, ending a 37-year career at the University of Wisconsin that has earned him international renown as a mathematician. From 1943-52, he was chairman, Department of Mathematics.

As director of the Mathematics Research Center of the U.S. Army, located on the University of Wisconsin campus, Dr. Langer will be succeeded by Dr. John Barkley Rosser, a similarly distinguished mathematician. Dr. Langer has headed the MRC since it was established in 1956.

Known as an authority in rocket ballistics, Dr. Rosser has been recognized with a Presidential Certificate of Merit and the Centennial Certificate of Merit from the University of Florida, among other honors.

DR. LANGER became a professor at Wisconsin in 1927 following a year as professor at Brown University and three years at Dartmouth as an instructor and assistant professor. He has served as a visiting professor at Ohio State University, Harvard, Stanford and the University of Texas.

Colleagues have honored Dr. Langer by electing him president of the Mathematical Association of America (1949-51), vice president (chairman of Section A) of the American Association for the Advancement of Science (1946), and vice president of the American Mathematical Society.

From 1943-46 he was editor of the *Bulletin of the American Mathematical Society* and from 1951-55 was editor of *Duke Mathematical Journal.*

Professional journals have recognized Dr. Langer's ability as a mathematician by publishing some 60 of his research papers, principally in the fields of differential and integral equations. In addition, he wrote the textbook, *A First Course in Ordinary Differential Equations.*

Born in Boston, Mass., Mar. 8, 1894, he earned his B.S., M.A. and Ph. D. degrees at Harvard University from 1917 to 1922. As a Harvard Sheldon Fellow, he studied at the University of Goettingen, Germany, 1922-23.

DR. ROSSER received B.S. and M.S. degrees from the University of Florida in 1929 and 1931 and a Ph. D. from Princeton in 1934. His career as a researcher, lecturer and instructor has included assignments at Princeton, Harvard, Cornell and Wisconsin. In 1943 he became a full professor at Cornell University, where he was chairman of the Mathematics Department (1961-62) until he joined the University of Wisconsin faculty.

Guggenheim and Fulbright · Research Fellowships enabled him to study at the University of Paris in 1954-54. Upon his return to the U.S., he joined the Stewart Committee that monitored U.S. space satellites.

Dr. Rosser has served as director of the Research Institute for Numerical Analysis at the National Bureau of Standards, chairman of the Mathematics Division of the National Research Council, and as a member in numerous honorary and professional organizations, including the Fellowship Board of the National Science Foundation.

Professional publications he has authored or coauthored include: *Theory and Application of Various Integrals, Logic for Mathematicians, Deux d'Esquisses de Logique, Many Valued Logics,* and *Mathematical Theory of Rocket Flight.* He also has prepared numerous papers on military rocket development.

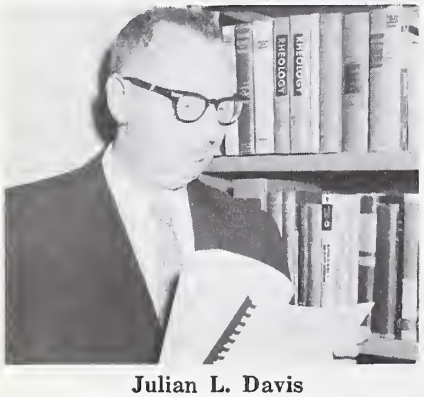
Picatinny Physicist Awarded SARS Fellowship

Picatinny Arsenal physicist Julian L. Davis has been awarded a Secretary of the Army Research and Study (SARS) Fellowship for a year of advanced study in continuum mechanics at New York University.

Davis will study under Prof. J. J. Stoker, chairman of the All-University Math Department, Courant Institute of Mathematical Sciences.

The SARS Fellowship Program was established in August 1956. Selection is based on a candidate's achievements and the creative potential indicated in the outline of his projected work. About a dozen Fellowships are conferred each year on talented civilians "to encourage creative attitudes to Army problems."

Davis has reported on his work in the *Journal of Polymer Science,* in *Transactions of the Rheology Society,* and has contributed to the *Journal of Aerospace Sciences.* In August he presented a technical paper on plastics at the Fourth International Congress on Rheology, Brown University, Providence, R.I.



Julian L. Davis

Davis' award provides for materials research in fundamental properties of elastic and plastic media with regard to their response to dynamic loading, shock wave propagation, vibration studies, etc. Mathematical techniques of nonlinear mechanics will be used in the study.

Educational qualifications of Mr. Davis include a B.S. degree from Brooklyn College and an M.S. from New York University. He has had considerable experience as an instructor, including courses in physics at Fairleigh Dickinson University and graduate courses in shock-wave and detonation phenomena at Stevens Institute of Technology. He is a member of the Society of Rheology of the American Physical Society.

At Picatinny Arsenal, he is employed in the Polymer Research Section of the Plastics and Packaging Laboratory. Earlier in his career he worked as a physicist for the Glenn L. Martin Aviation Corp., Republic Aviation Corp., and the Ballistics Research Laboratory, Aberdeen Proving Ground, Md.

Dugway E&D Laboratory Studies Aerosols, Wild Life

Among the many types of Army research activities seeking to improve the Nation's military posture, the Ecology and Epidemiology (E&E) branch at Dugway Proving Ground, Utah, if not unique, is unusual.

Operating over an area larger than Rhode Island, the E&E researchers have a mission that calls for continual charting of the status of infectious diseases spread by wildlife in the Great Salt Lake Desert area.

In addition to the experiments and studies required by Dugway's large testing program, the E&E branch cooperates closely with State and Federal health agencies and the Department of Agriculture. Joint efforts involve an extensive disease surveillance program.

Scientists and technicians work with about 45 species of rodents, 130 birds, many species of ticks, lice, mites and fleas, 250,000 head of cattle and 500,000 sheep and horses—all indigenous to the Dugway area—studying habitats and making serological tests for carriers and transmitters.

Because of the possibility of disease transmission to the skilled laboratory personnel, safety within the E&E facilities presents a major area of concern and planning. The resultant safety program includes the prime phases of operations; individual protection, area classification and handling techniques.

In the laboratory, individual protection is provided by airtight clear plastic ensembles, equipped with self-contained air supplies, boots and gloves hermetically sealed to the plastic suits. Periodic inoculations are given against diseases most likely to be encountered.

Individual protection is enhanced by classifying operating areas into "hot" or "cold"—according to whether they contain infectious atmospheres. An elaborate arrangement of airlocks, filter units, negative air pressure and sewage decontamination systems insures that uncontaminated areas are kept "cold."

Further, acid-detergent showers provide an effective cleansing method to allow passage between areas.

Equipment handling, the third phase of the safety program, is accomplished through the use of specially designed aerosol hoods and autoclaves. Finally, instruments and test equipment are always sterilized before and after use to control laboratory contamination.

During nine years of research and test development, safety precautions exercised by the E&E branch have produced an enviable record — proof positive that safety is a principal and continually applied policy at DPG.

DUGWAY PROVING GROUND Ecology and Epidemiology Branch technician conducts test with guinea pig in aerosol hood which enables laboratory personnel to engage in research with minimum infection risk.

DECONTAMINATION SHOWERS are taken by all personnel after leaving lab containing live lethal test agents. While dressed in protective suits, personnel undergo 15-minute bath mix of water, detergents, acid.

Mission of Mathematics Research Center Explained

Military requirements for the most advanced techniques of mathematics, increasing rapidly in recent years, explain the mission of the Mathematics Research Center, U.S. Army, established in 1956 at Madison, Wis.

In addition to performing research in applied areas of mathematics as an Army funded contract operation at the University of Wisconsin, the MRC furnishes guidance and assistance in mathematics research areas to Army facilities upon request.

The MRC also offers educational opportunities to Army mathematicians and others in the form of orientation lectures, advanced seminars, symposia and extended Residences at the Center, on the university campus.

Competence of the MRC to perform a function for which no parallel institution is operational for the Armed Forces is based on a staff of distinguished mathematicians.

Permanent staff members provide the required continuity to the Center's program; temporary members usually are on leave from other institutions, and their primary purpose is to keep interests of the Center current with regards to the newest mathematics trends.

Membership of the MRC staff and their major related fields of interests for the academic year which began in September 1963 are as follows:

G. S. S. Avila, T. L. Sherman and W. J. Coles, differential equations; S. D. Chatterji, B. Harris and L. Weiss, statistics; S. Cheng and M. Johnson, mechanics; H. E. Conner, branching processes; D. Greenspan, numerical analysis; V. Morley, H. M. Schaerf, W. Strodt and L. C. Young, analysis; J. O. Sather, A. Dou and V. Thomee, partial differential equations;

T. N. E. Greville, statistics, actuarial mathematics; M. N. L. Narasimhan, P. C. Jain and R. Manohar, fluid dynamics; H. Karreman, Operations research economics; S. C. Kleene, logic; R. E. Langer, ordinary differential equations; R. McKelvey, linear operators; B. Noble, M. Papadopoulos and C. H. Wilcox, applied mathematics;

L. B. Rall, numerical analysis, integral equations; W. L. Root, noise; J. B. Rosser, logic, numerical analysis; G. L. Saini, relativistic fluid mechanics; A. Sakurai, gas dynamics, magnetohydrodynamics; B. Scarpellini, differential equations, logic; H. Schneider, algebra; C. T. Taam and M. Urabe, nonlinear differential equations; W. Wasow, analysis, differential equations; J. P. Wright, mathematic physics; Y. Yoeli, switching; and H. J. Wertz, electrical engineering.

Questions and/or requests for mathematical assistance may be addressed to Dr. J. B. Rosser, director designate, Mathematics Research Center, U.S. Army, University of Wisconsin, Madison, Wis. 53706.

Nuclear Powered Energy Depot Concept Viewed for Modern Army

By Edward V. Duggan
Army Nuclear Power Division
Office, Chief of Engineers

Fuel supply has become one of the most urgent logistic problems faced by the modern field army. As a result of mechanization, today's ground forces are more mobile and more flexible—and they have acquired a giant's appetite for petroleum. Vehicle and aircraft engines, heaters and electric generators typify the consumer devices which, in aggregate, create the Army's vast fuel requirement.

An indication of the scope of this problem can be found in a comparison of shipping percentages. Fuel supply commanded about half the overseas logistic load in World War II. During the Korean War, the proportion spiralled to an estimated 70 percent, reflecting the increased dependence of forces on petroleum.

In a Theater of Operations, bulk alone is only part of the problem. More often than not, the consumer load is dispersed over a wide area, necessitating an intricate distribution complex of storage and carrier facilities. The more complex the system, the more vulnerable it is and the more it limits consumer mobility.

The Army Nuclear Power Program, a joint activity of the Department of Defense and the Atomic Energy Commission, has undertaken study of a Nuclear Powered Energy Depot.

Conceivably the system might relieve the field army of much of its logistic burden, giving our ground forces capabilities for independent action not enjoyed since the advent of petroleum-fueled vehicles.

The logistic advantages of nuclear power have been demonstrated successfully in applications to the heat and electricity requirements of permanent and semipermanent military bases. Development of mobile nuclear power plants, capable of supporting field installations, has advanced to where the appearance of rolling stock in the near future is anticipated.

The Nuclear Powered Energy Depot offers potentialities as a system which makes possible the division and distribution of the massive energy from mobile reactor plants.

Conceptually, the NPED utilizes the energy from a mobile reactor plant to either regenerate used fuels or fueling devices, or to produce new fuel from the universally available elements of air and water. It surmounts the basic incompatibility of the relatively large nuclear power plant and the small, scattered field army consumer devices by combining the characteristics of a fuel refinery and service station.

Several technical approaches to energy depot systems appear feasible. Systems currently being evaluated would produce liquid hydrogen or ammonia which then would be used in engines or highly efficient fuel cells to propel most types of land vehicles and aircraft.

The specific method for obtaining the hydrogen fuel would vary between situations, depending on economics and the importance of logistic savings. Where independence of operations is of primary importance and logistic burdens impose their severest penalty, hydrogen would be produced by electrolysis of local water.

An alternative system would employ reactor-produced heat or electricity to recharge battery-like devices. This latter concept is especially attractive since the state-of-the-art of fuel cells has advanced significantly in recent years. Electric drives may well become the standard vehicle propulsion mechanisms of the future.

A single loading of nuclear fuel will sustain operation of a mobile nuclear power plant for increasingly long periods—one to two years at present. Since the Energy Depot would operate on nuclear power, it also enjoys this advantage of logistic independence. It is comparable to giving a shipload of fuel the further advantage of air and overland transportability.

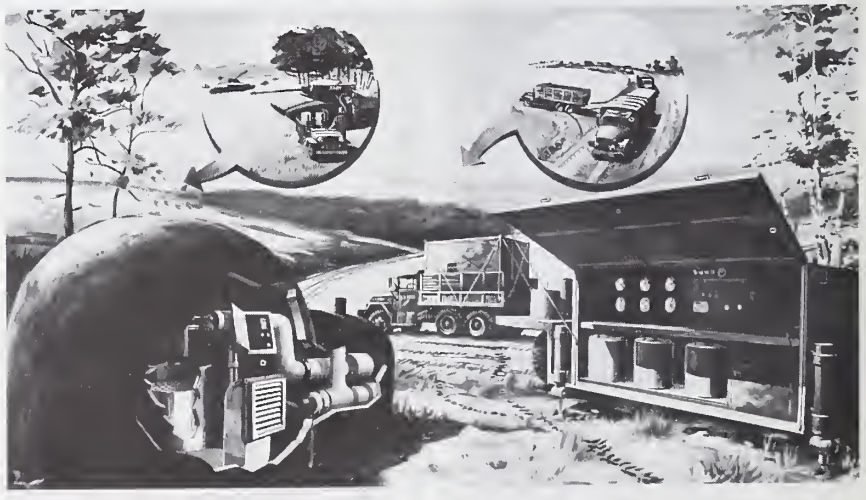
The Nuclear Powered Energy Depot system has the potential for:

- Allowing airborne commitment of holding forces for whatever time is necessary to establish the more conventional logistic complex.
- Endurance of large forces in the field which have been cut off from continuous CONUS logistic support.
- Allowing mechanized forces to cut themselves off from the logistic tail and penetrate deep into enemy area to ranges comparable with support aircraft.
- Air movement to advanced bases for support of the fuel demands of Army aircraft.
- The establishment of power and the construction of lines of communications in underdeveloped or devastated areas.
- Producing, at the destination, fuel for the return trip of strategic air transports and thus increasing the outbound tonnage capacity by 30 to 50 percent.

Because the Nuclear Powered Energy Depot concept does not substitute a product improvement in the existing fuel supply system, it is difficult to evaluate at present its merit in terms of cost effectiveness.

Ultimately the depot might involve the wide-scale substitution of a new system of fuel logistics, the introduction of new military capabilities, and the alternation of many time-tested operational standards.

The Nuclear Powered Energy Depot should be recognized as the only system currently under study that offers the field army the promise of ultimate freedom from the traditional logistics tail. It is an exciting concept for the future, with success dependent upon considerable developmental work.



Artist's concept of Nuclear Powered Energy Depot showing reactor complex, lower left, and fuel producing complex. Insets show fueling of vehicles.

FASEB Completes Study for Army on Ascorbic Acid

The Federation of American Societies for Experimental Biology (FASEB) has completed a study on military applicability of research on ascorbic acid (vitamin C), under the direction of the U.S. Army Research Office (USARO), Life Sciences Div.

Supported by the USARO contract with FASEB for life sciences consulting services (see Newsmagazine, August 1962, p. 7) the study was directed at identifying many questions yet unanswered on the role of ascorbic acid in the human body.

FASEB convened an Ad Hoc committee of 21 leading experts to discuss the field of knowledge on ascorbic acid. Dr. Francis W. Morthland, USARO project officer for the study, said several attendees found their previous convictions shaken and that information for thorough understanding was incomplete.

The role of ascorbic acid in the prevention of scurvy has long been known. A classical description of the disease state known as scurvy and some hints on its prevention were written by James Lind in 1753.

The results of daily doses of lime juice or other citrus fruits, originated by the British Navy, are well known and provided one of the first big clues to all later vitamin research.

Even though ascorbic acid is a material required for the health and well-being of all animal species studied, oddly enough, man is one of only five known species that cannot synthesize it in their own tissues. This biochemical lack is shared with the other primates (monkeys, apes, etc.), the guinea pig, a rare bird, and a fruit-eating bat. The latter two were discovered recently in India.

These five species rely upon a daily intake of the vitamin in their food to maintain good health since their tissues do not store it for reserve.

The National Research Council recommends for humans a minimum daily intake of 70 mg. per day to prevent the overt signs of scurvy. Most Americans exceed this requirement in the average daily diet.

Experiments indicate that a daily intake of 100 to 150 mg. is required before tissues show signs of saturation. With current evidence indicating that general health improves with intakes up to the saturation levels, presently planned combat rations will provide about 250 mg./day.

In the badly stressed human (battle wounds of severely burned patients), much larger amounts of ascorbic acid, up to 1,000-2,000 mg./day, are required before the body shows signs of saturation by excretion of the excess. Empirical evidence indicates that this extra intake hastens healing processes.

Despite the early discovery of the role of ascorbic acid in human nutrition and empirical indication of value, many questions remain.

- How does it react biochemically in the body?
- How does it aid wound-healing processes?
- Does it help in periods of extreme fatigue or in strong psychological stress?
- What are the interrelations to supplies of other vitamins and other esential nutrients?
- Are there military requirements for a larger than normal intake of ascorbic acid under battle conditions?

The initial FASEB conference and studies to date have stimulated much thought among the experts, and it is anticipated that resulting research will have long-range effects on military and civilian health.

HFR&D Group Reviews Aviation Program Needs

Specific requirements for additional support necessary for the Army aviation program were considered by the Army Human Factors Research and Development Committee Nov. 19-20 at Fort Rucker, Ala. The U.S. Army Board for Accident Aviation Research was host.

Discussions involved representatives of the U.S. Army Combat Developments Command, Army Materiel Command, Army Aeromedical Research Unit, Army Personnel Research Office, and the Human Resources Office of George Washington University in Alexandria, Va. A working group representative of these agencies was formed for further study of the over-all problem.

Colonel William G. Sullivan, chief of the Human Factors and Operations Research Division, U.S. Army Research Office in Washington, set the framework for the discussions in an advance letter to all agencies represented. Army Chief Psychologist Dr. Lynn E. Baker of his staff presided as chairman.

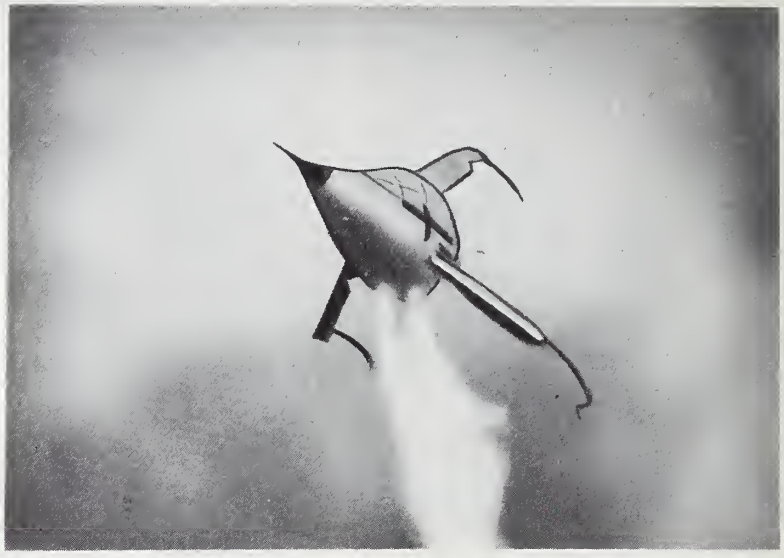
Brig Gen David Parker, CG of the Army Aviation Support Command at St. Louis, Mo., spoke on "Human Factors in the Development Phase of the Army Aircraft Cycle," "An Overview of the Army Aviation Program" was discussed by Col George W. Putnam, Office, Assistant Chief of Staff for Force Development, Washington.

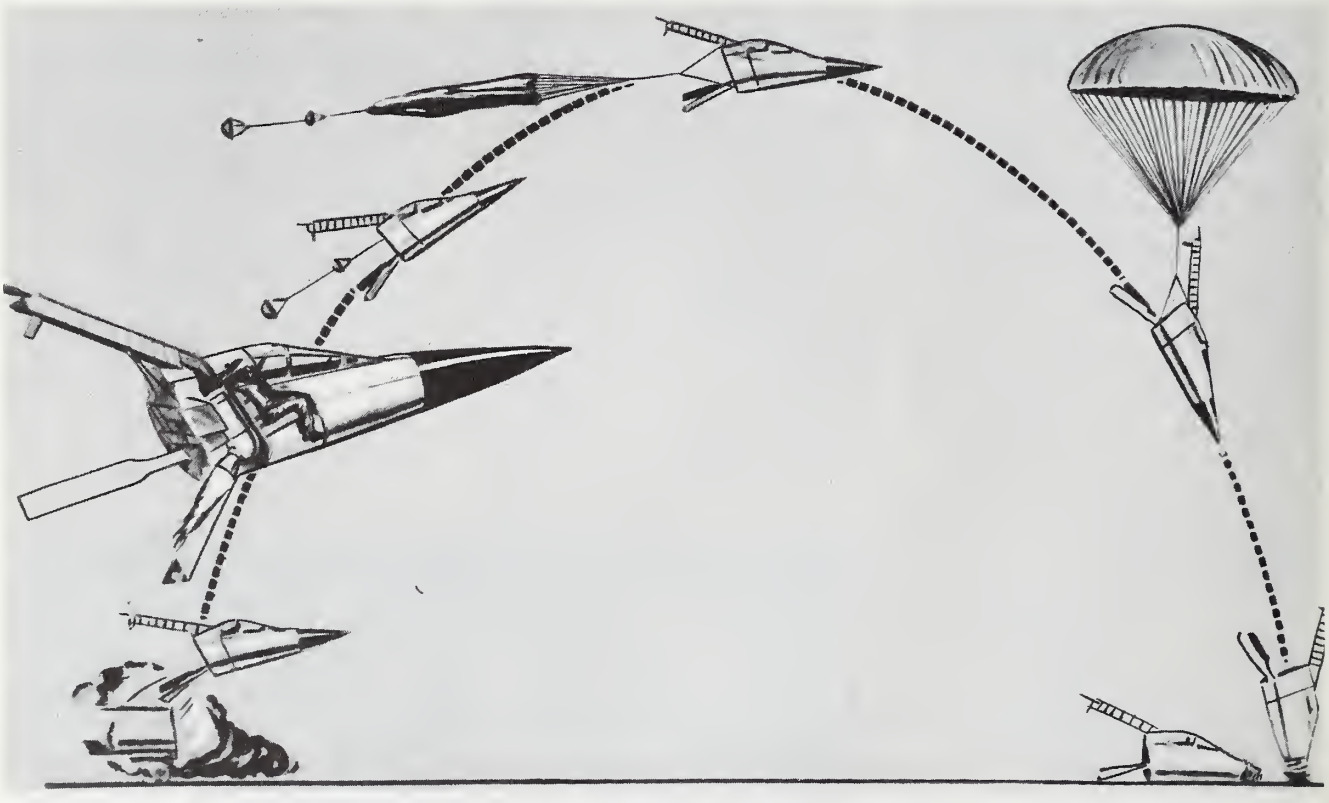
Other leading speakers included Col Robert M. Hamilton, director, and Col R. P. Bonasso of the Army Aviation Test Board at Ft. Rucker; Howard E. Futch of the Army Materiel Command Iroquois Project Office and James E. Beach, Chinook Project Office, AMC Headquarters; Dr. J. Rupe of HumRRO in Alexandria and Dr. W. Prophet of HumRRO at Fort Rucker; Dr. J. E. Uhlaner of the Army Personnel Research Office; Lt Col W. Johnson, TRECOM and Lt Col William Hausman, Army Medical R&D Command; J. Stevens of the Army Human Engineering Laboratories; and Dr. Ralph Dusek, U.S. Army Natick (Mass.) Laboratories.

Army Human Factors Engineering Committee members shown at Fort Rucker, Ala., meeting are (left to right) Col Robert M. Hamilton, director, U.S. Army Board for Aviation Accident Research; Jacob Barber, secretary; Dr. Lynn E. Baker, chairman; and Col W. G. Sullivan, Army Research Office.

XM-15 Ejector Offers Survival Hope for Jet Pilots

ROCKET MOTOR FOR XM-15 CATAPULT





XM-15 Aircraft Escape and Rescue System.

Positioned at rear of pilot's seat, the rocket motor for the XM–15 catapult (upper left) is packed with solid-propellant charge that instantaneously delivers enormous precision-controlled energy. The funnel-shaped exhaust, which directs 50,000-pound thrust, canted at a 62-degree angle to intersect the capsule center of gravity, hurls the 2,400-pound capsule free of the plane within 45/1000th of a second upon ignition. The XM-15 escape capsule is shown (upper right) a split-second after separation from the plane's fuselage. Automatic release of the stabilizing vanes prevents rolling while the rocket motor pushes the capsule free of any possible entanglements and to the required height for release of a recovery chute from the tail structure. Action drawing (below) depicts stage-by-stage escape flight duplicating ejection tests from a plane on the ground at Edwards Air Force Base, California.

Survival hopes for a fighter pilot in a disabled plane traveling at supersonic speeds are enhanced greatly by a split-second ejection system that has passed preliminary Army tests.

As announced early in December, major credit for the XM-15 Escape Capsule Rocket system is being accepted by the U.S. Army Munitions Command Solid Rocket Propulsion Laboratory at Picatinny Arsenal, Dover, N. J.

An article titled "Frankford Arsenal Applies PAD Knowledge to Flight Problems," page 35 of the September 1963 issue of this publication, written by Robert F. LeVino, reports on contributory effort. Frankford has worked on PAD (Propellant Actuated Devices) for pilot emergency systems for about 17 years, and has an enviable reputation in the field.

The new ejection system, operable either automatically or manually, transforms the plane's cabin within 15/1000th of a second into an escape capsule. It is ejected from the aircraft's fuselage by a 50,000-pound thrust from a solid-propellant motor.

Encased in the capsule, the pilot is protected from crushiing atmospheric pressure and freezing temperatures during the descent to earth from high altitudes. System engineers report that whether the pilot lands in mid-ocean or in a desolate land area, he is protected from the elements, has freedom of action within the waterproof, airtight capsule, and can direct rescuers to his exact position.

Success of the system hinges largely on faultless operation of the ejection rocket that blasts the whole nose section free with tremendous but precision-controlled force. Recent tests conducted at Edwards Air Force Base in California established reliability under a variety of conditions.

Immediately foreseeable applications of the escape capsule rocket system include the future space vehicles orbiting American astronauts and the TFX aircraft.

In the Edwards AFB tests, the capsule was first subjected to simulated ejection from a plane malfunctioning during ground run-up. The capsule was ejected to the required altitude for deployment of the parachute in time to provide a soft landing at a safe distance from the presumably exploding or burning plane.

Next came a series of rocket sled tests, simulating velocity conditions existing up to 70,000 feet altitudes and speeds as high as 1,750 m.p.h. Tests planned in the near future will use the sled to simulate capsule ejection at the peak altitude of 100,000 feet and speeds up to 2,500 m.p.h.

The announcement from Headquarters, U.S. Army Munitions Command at Picatinny Arsenal said the Solid Rocket Propulsion Laboratory "because of its extensive experience and know-how in designing solid rocket devices was selected to design, develop and test the ejection rocket."

Arthur LoPresti heads an SRPL staff of 50 engineers and scientists and is known as one of the pioneers in development of a variety of rockets, jatos, missile power plants, propellant formulations and gun-boosted rockets. Management of the XM-15 Escape Capsule Rocket project was assigned to Frederick Menke and Stephen Harnett, employed as mechanical engineers in the SRPL.

The developmental team at the SRPL encountered numerous design problems involved in a motor with a thrust sufficient to separate the airplane nose against the tremendous air stream pressure of supersonic flight, coupled with the thrust build-up measured in 1/1000th of a second.

For one thing, these requirements had to be kept within gravitational force limits to avoid subjecting the pilot to possibly fatal gravitational forces at the instant of ejection. Another critical requirement was to maintain precision control over the direction of this enormous blast of energy to keep the ejected nose from spinning out of control.

MOCOM Tech Director Began Career as Toolmaker

A first glimpse at the acting technical director of research and development at Headquarters of the U.S. Army Mobility Command (MOCOM) might not disclose behind his ready smile a driving determination to succeed against odds.

Irving Appelblatt started as an apprentice toolmaker at the age of 15 and earned a college education by working days and attending classes at night. For eight years a large chunk of his earnings went toward educational goals.

Now, at 43, he can look back with good reason to smile. The sweet smell of success is his as the top civilian in the research and development effort of a command which is responsible for, or conducts R&D, procurement, production and supply management of "everything in the Army which creeps, crawls, rolls, flies or swims."

Appleblatt participates in all major aspects of planning, coordinating, executing and appraising the Command scientific programs involved in research and development.

A native of Brooklyn, N.Y., he lives in Detroit with his wife, Hilda, and three children, Carole, 15, Linda, 13, and Steven, six.

Appelblatt attended Wilbur Wright High School in Detroit and participated in a co-op plan which enabled him to work as an apprentice toolmaker for two weeks each month and attend classes for two weeks.

In 1939 he started night classes in mechanical engineering at Lawrence Tech and won his degree in mechanical engineering in 1947. During this period he worked days at such places as the Ford Motor Co., General Motors, and the Detroit Arsenal.

From 1947 to 1951, he was a professor nights at Lawrence Tech, teaching engineering mechanics, strength of materials and machine design. He worked days at the same time and continued this gruelling schedule until, as he puts it, "I ran out of gas."

At the Arsenal, he was chief of the Tracked Vehicle Branch, Deputy Chief of the Product Engineering Division, and Chief of the Engineering Division, Research and Engineering Directorate.

His chief outdoor hobby is golf and indoors he puts together various types of electronics equipment.

His affiliations include the American Ordnance Association, Engineering Society of Detroit, Russell Lawrence Foundation, and Association of the U.S. Army.

He has been selected as one of the recipients of the 1963 Lawrence Tech Alumni Association Award.

Irving Appelblatt

APG Theory of Probability Work Aids Product Quality Control

In 1447 a Venetian critic of Dante's *Divinia Commedia* speculated on the probability of the various throws that could be made with three dice. By the 17th Century, Bernoulli, Laplace, and others had developed the theory of probability. But it was still associated in the popular mind with games of chance.

Today that theory is a powerful industrial tool for controlling the quality of products, increasing operating efficiency, and helping management make thousands of decisions. It serves to assure the manufacturer that one of his razor blades is as sharp as the next, that one bottle of beer tastes the same as the next, that one electron tube functions as well as the next.

Until the 1930s the theory of probability was applied mostly to insurance risks. In 1926 at the Aberdeen Proving Ground, Md., Dr. L. S. Dederick began working out applications of probability theory to ballistic problems, and there it was a few years later that one of the first large-scale applications of statistical theory evolved.

The Ordnance Corps decided to send samples of ammunition stored in many parts of the world to Aberdeen Proving Ground for firing and other tests to make sure the U.S. ammunition supply was operational.

Because the Surveillance Group, established at Aberdeen under Capt L. E. Simon, now a retired major general, could not shoot up all the ammunition to see how well it functioned, some statistical method had to be found. By 1940 a scientific technique of evaluating stockpile reliability had become a part of the Ballistic Research Lab's program.

Working with BRL's R. H. Kent and J. R. Lane, Capt Simon arrived at procedures for sampling and testing which could estimate accurately the reliability of the war reserve ammunition by shooting relatively few samples. One of the striking results of this work was the high accuracy of artillery fire in the Normandy invasion. BRL's efforts and these results set the stage for the standard sampling inspection procedures for the Army, Navy and Air Force.

After World War II, the Surveillance Group, then headed by Dr. Frank Grubbs, stimulated interest in the application of statistics to a variety of industrial problems. BRL statisticians developed techniques, prepared reports, papers and books, addressed professional and scientific societies.

Extensive tables of the binomial probabilities were tabulated by the BRL and distributed throughout the Federal Government, its contractors, and the universities. These tables were also printed by the Department of Commerce and sold to the public.

Statistical quality control was originated by Dr. W. A. Shewhart of the Bell Telephone Laboratories when he published the first book on the subject in 1931. BRL's adaptation of these techniques to huge problems in ammunition inventory stirred the imagination of industry. Contractors of the U.S. Army first began to apply the new statistical sampling procedures to the production of munitions.

Very soon many industries were asking BRL for information on other techniques to control production quality. Requests poured in for the

Weather Experts Consider Improved Radar Accuracy

Methods of increasing accuracy of radar readings used in weather predictions were discussed by meteorological experts at a 2-day conference held late in November at Fort Huachuca, Ariz.

Sponsored by the U.S. Army Electronics R&D Activity (USAERDAA) at Fort Huachuca, the discussions involved Professors L. J. Battan of the Institute of Atmospheric Physics and E. L. Morris, director of the Applied Research Lab, University of Arizona.

Wayne Johnson, chief of the U.S. Weather Bureau Research Group at Fort Huachuca, D. E. Little of Pan American World Airways, Chief Scientist J. J. Lamb, K. M. Barnett, A. V. Carlson and Lt E. Kirschner, all of USAERDAA, were among the other participants.

ERDL Expands Info Service, Dedicates New Library

A major effort at the U.S. Army Engineer Research and Development Laboratories to improve technical and scientific information service touched a high note in November when a new library was dedicated.

The library is located in the new technical engineering building, completed in August 1963, and has about 3,200 square feet of floor space, as compared to 1,200 feet for the old library. A new feature is a separate microfilm reading room.

More than 12,000 books, 3,000 bound volumes of journals, 200 reels of microfilm, 2,500 commercial catalogues, 2,000 translations, 2,000 standard and miscellaneous pamphlets, 300 periodical subscriptions, and some 50,000 Department of the Army publications are stored in the library.

The Scientific and Technical Information Branch, headed by Carlos O. Segarra, is developing what he terms a comprehensive and totally integrated system called TECHLARS (Technical Literature Analysis and Retrieval System.)

The system is designed to help scientists, engineers and management personnel by providing information needed for R&D decisions. Other objectives are to accelerate the flow of technical communication among Department of Defense agencies, industries and university research teams; and to improve overall R&D program planning and scheduling.

Col J. H. Kerkering, commander of the Engineer R&D Laboratories, dedicates new ERDL library. With him are (left to right) James E. Wideman, chief of Administrative Services Department; Thomas R. Jones, librarian; and Carlos Segarra, chief of the ERDL Scientific and Technical Information Branch.

standard sampling inspection tables used in quality control.

Information developed at BRL was disseminated widely and put to use in improving the quality and uniformity of manufactured items. The BRL statistical methods were also employed in setting up specifications such as those for electron tube operation and testing of materials.

Sampling inspection schemes for control of quality were first used on simple production lines. When the inspection uncovered a defective, the machines were stopped until the trouble was found. Now such schemes are used at every step of the manufacturing process, from raw material through final product, to indicate when the quality of the product is varying more than can be tolerated.

Controls are used to detect tool and instrument wear, variations of product caused by temperature and humidity, and occasional misalignments of the running machinery. Quality control techniques provide the manufacturer with a prompt guide to the discovery of trouble and its economical elimination.

Industrial management quickly recognized the utility of statistical tools in problems other than the control of quality of manufactured products. Demands were made for other techniques BRL statisticians worked out.

Sugar refiners and instrument makers used a procedure developed by Dr. Grubbs for separating the error in the measuring instrument from the variation in the item being measured. Psychologists, particularly at the University of Wisconsin, University of Texas, and Harvard University, became interested in BRL information showing the power of statistical tests to detect significant differences in sets of measurements.

Some of the information developed at BRL found unexpected applications. Dr. Grubbs' work on testing of outlying observations gives a procedure for deciding whether to include or discard a maverick observation that does not seem to "belong" with the rest of the observations. Used now in many parts of the world, the technique is helpful when physical reasons for the maverick are not known.

This procedure has found application in the beer industry and in the School of Hygiene and Public Health at Johns Hopkins. It is being used in the University of Melbourne and has been translated and reprinted for use by the members of Japanese industry. One request for this information came from a university group studying ways of managing big game in North American countries.

The original article on the rejection of outliers, published in *The Annals of Mathematical Statistics* of 1950, has become a standard of the American Society for Testing Materials. The society recommends the standards for testing all types of materials for acceptance. Industry uses them for products ranging from safety pins to steel ingots.

Twenty-five years ago the probability was very low that a technique developed at the U.S. Army Ballistic Research Laboratories for analyzing the range of artillery shells would be of specific use to a zoology department at a major university. Even the handful of pioneers who developed and promoted statistics in the 1930s probably never anticipated such a wide audience.

The American Society of Quality Control, which General Simon and Dr. Grubbs helped found in 1944, listed 16,000 members in 1963—ample evidence of the phenomenal growth of interest in statistical methods.

AMC Hosts 550 at 5th Liquid Propulsion Symposium

Armed Forces leaders were prominent among about 550 participants in the 5th Liquid Propulsion Symposium at Tampa, Fla., Nov. 13-15, including U.S. Army Materiel Command and U.S. Army Research Office directors.

Lt Gen Bruce K. Holloway, deputy commander-in-chief of the U.S. STRIKE Command, and keynote speaker for the classified sessions, was introduced by Maj Gen Frank H. Britton, director of R&D for the U.S. Army Materiel Command.

Director of Army Research Brig Gen Walter E. Lotz, Jr., served as chairman of the first session. His speech on "Future Requirements," in which he termed NASA's role as "out of this world," the Air Force program geared to requirements of the "wild blue yonder" and the Army's needs as "down to earth" mobility advances, was well received.

Among other leading speakers at the opening session were Donald M. Ross, technical director, Air Force Rocket Propulsion Laboratories at Edwards Air Force Base, Calif.; Dr. Colin M. Hudson, technical director of the Development Division, R&D Directorate, Army Materiel Command; Benson E. Gammon, chief of Research and Technology at NASA Headquarters, Washington, D.C.; and Irving Silver, division engineer, Missile Propulsion Division, Bureau of Naval Weapons.

Harold E. S. Jersin of the Materiel Command, general chairman, and E. O. Andrews of the Chemical Information Agency at Silver Spring, Md., who served as coordinator, said about two-thirds of the attendees were representative of industry, educational institutions and nonprofit research firms.

The Liquid Propulsion Symposium is the major conference on rocket propulsion utilizing liquid propellants, and is attended each year by the Nation's leading scientists and engineers in this field. The U.S. Army Materiel Command was host for the meeting this year.

Sponsorship of the symposium is shared by the Departments of the Army, Navy and the Air Force, the Advanced Research Projects Agency of the Department of Defense, and the National Aeronautics and Space Administration. Jointly they compose the Interagency Chemical Rocket Propulsion Group.

Director of Army Research Brig Gen Walter E. Lotz, Jr. (left), Deputy CinC Lt Gen Bruce K. Holloway of the U.S. STRIKE Command and Maj Gen Frank H. Britton, Director of R&D for the U.S. Army Materiel Command, were among top military participants in 5th Liquid Propulsion Symposium.

Army Medical Service History of Progress Touches Upon Lives of Many Millions in All Parts of World

Trace the long, long trail of Army Medical Service research achievements serving the welfare of all humanity and you cover the wide world.

Medical Service science, like all Army research, is oriented primarily to military problems. Objective: To keep the American soldier in the best possible physical condition at all times—and when he is incapacitated by illness, injury or battle wounds, restoring him to duty with a minimum of lost time and with maximum vigor to resume responsibilities.

Physical ailments, however, make no distinction between the man in uniform and the civilian. What is good for the soldier stricken with malaria, amoebic dysentery, tuberculosis, epidemic hemorrhagic fever or any of hundreds of other diseases is equally beneficial for civilians.

When the U.S. Army Medical Service initiated in 1962 a 5-year research, development, test and evaluation program "to meet forecasted requirements for any kind of war in any kind of environment," the announcement, in effect, was an open declaration of interest in medical problems everywhere. The projected program was the result of detailed joint planning and effort.

The Armed Forces Epidemiological Board (AFEB), composed of top civilian scientists, and the Army Scientific Advisory Panel were among organizations that assisted the Army Surgeon General in developing the 5-year program. It is centered in 15 project areas, with emphasis on preventive medicine. (For a detailed account, see June 1962 issue, page 6.)

Millions of civilians, particularly those in remote, underdeveloped areas, will benefit from the Army Medical Service 5-year program. This has been true ever since the Army Medical Service began its pioneering efforts 188 years ago.

The honor roll of Army medics who have made notable contributions to scientific knowledge for the benefit of mankind would be an endless list. Day by day, it grows—physicians, surgeons, bacteriologists, neuropsychiatrists and highly skilled specialists in virtually all of the multitude of physical ailments known to humans.

Since the introductory issue of this publication carried feature articles on significant Army Medical Service research in two fields—articles titled "WRAIR Germfree Research Opens Vistas" and "Brooke Army Medical Center Pioneers in Treating Burns"—subsequent editions have attempted to report on important advances in methodology or medical equipment.

The Surgeon General
Lt Gen Leonard D. Heaton

Even during that relatively brief period of three years, the story of Army medical progress is impressive. Sixteen years of pioneering research to create a better way of life for thousands of amputee patients everywhere won for Col Maurice Fletcher, in August 1961, the Academy of Achievement's Golden Plate Award. All those years he headed the Army Prosthetics Research Laboratory of Walter Reed Army Medical Center.

Results of that research have given thousands of amputees in all parts of the world more comfortable, normal looking artificial hands, arms, legs and other prosthetic devices, helping them to find a useful way of life.

Further recognition of the work of the Army Prosthetics Research Laboratory came in January 1963 when Scientific Director Dr. Fred Leonard was presented the Department of the Army Meritorious Civilian Service Award for research in materials suitable for a variety of internal body uses, such as vascular prosthesis, and for smooth-surfaced porous laminates.

Notable also in its vast potential benefits, though admittedly still requiring a great deal of advanced research, is the Army's experimental artificial heart pump.

Controlled by principles of fluid dynamics, without moving parts other than artificial ventricles and tricuspid heart valves, it has proved superior to existing heart pumps in an extended series of heart bypass experiments on animals. Developmental work is assigned to a team of Harry Diamond Laboratories-Walter Reed Army Institute of Research personnel.

Research on a dramatic new method of electrical anesthesia, which if perfected will have many advantages over present methods, is being continued under an Army Medical Service contract. Results in extended tests have been encouraging, as first reported in the March 1961 issue of this publication.

Biological research aimed at problems that could affect vast numbers of people is being pursued with a 50,000-watt nuclear reactor dedicated at the Walter Reed Army Institute of Research in September 1962. Only 11 months earlier a "pulse" reactor, capable of simulating bursts of radiation produced by an atomic explosion, was dedicated at Walter Reed Army Hospital's annex at Forest Glenn, Md.

Steady progress also is reported by medical researchers and contract agencies in efforts to develop a ruggedly reliable field X-ray. In January 1962, this publication reported on field tests of an 85-pound portable unit. Several months later tests were made on a 57-pound unit, and it is envisioned that a unit weighing less than 40 pounds can be produced. The application of such a unit in major civilian disaster areas might contribute to the saving of many lives and efficient treatment of injuries.

International publicity came to the Army's prolonged search for effective immunization against German measles when it was announced in October 1962 that Walter Reed Army Institute of Research scientists had isolated the virus simultaneously with Harvard University researchers.

The American Heart Association again recognized research at WRAIR by presenting to Dr. Donald E. Gregg in November its 1963 Research Achievement Award. Dr. Gregg, chief of WRAIR's Department of Cardiorespiratory Diseases, was honored for heart disease research. In August 1962, the late President John F. Kennedy presented to him the President's Award for Distinguished Federal Service in this field.

Contributions of Dr. Gregg to the knowledge of heart diseases have received worldwide recognition as important discoveries. They include the design and development of a micromanometer for measuring blood pressures, the rotameter for measuring blood flow, and the densitometer for determining cardiac output and coronary flow by means of dye injection.

Investigators working on heart disease and arteriosclerosis, the physi-

ologist probing cardio-pulmonary functions at high altitudes, and the diagnostician in a busy city hospital all will share in benefits of his work.

Rapid mobility requirements of the Army Medical Service for modern warfare are being served by a new MUST (Medical Unit Self Transportable) announced in the November 1963 issue of the *Army R&D Newsmagazine*. This unit obviously will have many applications to civilian disaster areas.

Add to this sketchy 3-year list of achievements the thousands of technical papers and articles in professional journals authored by Army Medical Service personnel, reporting on progress in virtually all areas of medical research, and the overall immediate and potential application to civilian needs can be appreciated.

Army Medical Service history serves to stimulate that appreciation. The *Annals of Medical History, Medical Life,* and the *Bulletin of the History of Medicine* at Johns Hopkins University, for example, supports the claim that no other group has made a more notable contribution to writings on the medical history of the Nation than Army Medical Service.

Anyone even faintly knowledgeable about that history is aware of the contribution of William Beaumont, an Army surgeon, whose 1833 publication, *Experiments and Observations on the Gastric Juice and the Physiology of Digestion,* is regarded as the basis for the science of gastroenterology.

When Army Surgeon General William A. Hammond established the Army Medical Museum in 1857, he laid the foundation for what is today the world-renowned Armed Forces Institute of Pathology. No elaboration of the importance of this Institute to civilian medicine is necessary.

Dr. Marion B. Sulzberger
Technical Director of Research
U.S. Army Medical Service

Brig Gen Robert E. Blount
CG, Medical R&D Command

Along the historical trail of Army medical research one finds giant-sized markers for such men as Major Walter Reed (famed for yellow fever research), and Col William Gorgas (later a major general and The Surgeon General) who used that knowledge to eradicate the disease during construction of the Panama Canal.

No less conspicuous place of honor among medical research immortals is occupied by an earlier Army Surgeon General, George M. Sternberg, who worked on yellow fever before he chose Maj Reed to head a research board. General Sternberg is known also as the author of the first American textbook on bacteriology, the first man to photograph the tubercle bacillus, and the driving force that established the Army Medical School in 1833, "America's oldest school of preventative medicine," now known as Walter Reed Army Institute of Research.

The purpose of this article is to provide a general insight rather than a comprehensive review of Army Medical Service achievements in research. A once-over-lightly look at some work being done at various centers follows.

FACIAL PROSTHESES. Loss of portions of the face as a result of injury or surgical causes is a harrowing experience for the patient. The need for prosthetic replacements requires the combined efforts of the plastic surgeon, maxillofacial prosthetist and chemist. Though the number of such patients is small, the "need number product" index is large.

In response to referral of patients from the Department of Plastic Surgery, Walter Reed General Hospital, the U.S. Army Medical Biomechanical Research Laboratory of Walter Reed Army Medical Center at Forest Glenn, Md., undertook development of methods and materials for the production of facial prostheses of long-term utility.

Fabrication of facial prostheses, such as ears, noses, cheeks and lips present difficult and complex problems in obtaining impressions and in constructing molds. The heterogeneity of tones and shades and illusion of depth present in the human skin require the artist to develop new techniques in tinting and coloring in plastic media.

Problems involved in developing suitable materials for use in this application are also complex. Major difficulties which arise in the preparation and wear of facial prostheses may be attributed to deficiencies in available materials.

Efforts have been made to apply natural and synthetic materials prepared for other applications, but for one reason or another the materials have exhibited shortcomings which yield less satisfactory prostheses.

For a material to be applicable to use in facial prostheses it must have good tissue receptivity, i.e., produce no dermatitis and be non-toxic and non-allergenic to the wearer. It must lend itself to accurate forming and fairing with retention of fine detail and without the introduction of obvious parting lines or distortion.

A certain translucency is required and the material must be essentially colorless, so that it may be tinted to skin tones. The material must have permanence, i.e., exposure to skin fluids, outdoor weathering and resistance to ordinary stainants must be outstanding.

If the material is stained it should be easily cleansible with ordinary household cleaners. The material should have a flexibility compatible with movements of the surrounding skin to which it is adhered and it must be resistant to tearing.

Such a material, a latex dispersed saturated acrylic acid ester elastomer, has been synthesized at the U.S. Army Medical Biomechanical Research Laboratory and techniques developed for its use in the fabrication of facial prostheses.

Practical clinical applications have been carried out over the past several years for about 75 patients. Results of clinical trials indicate that the new materials have several advantages, including: They may be processed in cheap plaster of Paris molds in contrast to the necessity for using more expensive plastic or electroformed metallic molds; they are resistant to irreversible staining and have excellent weathering resistance.

VIRAL HEPATITIS. Infectious

hepatitis has been recognized as a major worldwide military and civilian problem since World War II. During the Korean War, the equivalent of two companies of soldiers was lost yearly from each division due to the disease.

Sanitary measures reduce incidence but fail during combat operations when conservation of manpower is most needed. Newer techniques of viral isolation have led to the hope that a vaccine can be developed which protects troops from viral hepatatis.

A joint Walter Reed Army Institute of Research-Armed Forces Institute of Patohlogy mission was established in September 1962 to obtain infective material from patients with documented hepatitis.

Maj Marcel E. Conrad, Capt Franklin D. Schwartz and M/Sgt Allen A. Young were sent to Korea from WRAIR during September 1962. The team was organized to carry sufficient materials and equipment to obtain, prepare, store and transport biologic specimens for future virologic studies and also to obtain and prepare tissue specimens for both light and electron microscopy.

Additional support for laboratory work and supplies was arranged with the 406th General Medical Laboratory in Japan and the clinical laboratory of the 121st Evacuation Hospital in Korea prior to departure.

Twenty-five consecutive servicemen admitted to the 121st Evacuation Hospital with clinical hepatitis volunteered for this study. The clinical and laboratory course of this disease was documented in a systematic fashion by the project officer. Serial biopsies of the liver, gut and kidney were obtained from each patient.

When changing conditions precluded continuation of the project in Korea, the patients were transported en masse to Walter Reed General Hospital by what is believed to have been the longest jet aeromedical evacuation in history.

Daily observation of the patients was continued by the project officers until each volunteer recovered and could be returned to duty. Clinical and laboratory follow-up of each patient every 3 months was arranged with their nearest military facility.

One year after the onset of clinical illness each volunteer remaining on active duty was rehospitalized at WRGH for documentation of recovery or residuals of his illness by means of clinical, laboratory and biopsy examination.

The data and materials obtained from this study provide the basis for a bank of acute and convalescent sera from proven cases of viral hepatitis which is maintained at the AFIP. Biopsies have documented the presence of intertinal and renal pathology.

Continued study of the material obtained from this project and similarly organized studies, the researchers hope, will result in an understanding of the pathophysiology of viral hepatitis and isolation of a causative agent. The knowledge then can be used to produce a vaccine to eradicate this disease as a threat to military operations and to ameliorate a worldwide health problem.

Success in this endeavor will result in the prevention of the loss of several companies of soldiers per division when they are vitally needed. Distribution of this disease, with both sporadic and epidemic occurrence, indicates no group is free from danger. Groups living under conditions of poor sanitation and personal hygiene are particularly susceptible.

INTRAVASCULAR BLOOD CLOTTING. Research supports the belief that blood is continually clotting and the clot is continually being dissolved, or lysed, during its normal circulation in the body.

Recent work in the Division of Clinical Surgery, Walter Reed Army Institute of Research, indicates that under certain circumstances this clotting of blood, particularly in the small vessels, or capillaries, may proceed to abnormal amounts and temporarily occlude the microcirculation in vital organs such as the liver and kidneys.

Widespread clotting may cause a clotting defect with a bleeding tendency, which may be aggravated by the body's own protective mechanism when it secretes heparin, a substance which halts clotting and fibrinolysin, a substance which dissolves clots.

Severe or even fatal hemorrhage may follow. Cells of the liver, kidneys and other vital organs, deprived for a time of blood supply may die even though circulation is soon restored by dissolution of the small clots. This may be responsible, in whole or in part, for a wide variety of disease pictures in man.

Included are severe disorders of the liver, kidneys, or pancreas, various allergic reactions, surgical bleeding, clotting abnormalities, rejection of transplanted tissue, or irreversible shock.

Some factors which trigger off these events are:

- Slowing of the blood flow through the capillaries as occurs in shock.
- Liberation of a clotting factor in normal red cells by abnormal destruction of these cells.
- The addition to the blood stream of clot-inducing substances found in dead or injured tissue, cancerous tissue, or foreign tissue from another individual.
- Activation of the clotting process by contact of the blood with foreign surfaces such as occurs in the use of an artificial heart and lung.

In all types of injury both civilian and military, this "intravascular clotting" appears to be a problem which if untreated may in many cases lead to a fatal outcome.

Although the experimental work has been done on animals, observations in human cases confirm these changes in the blood and illustrate minute clots in the capillaries. Research is continuing to define mechanisms involved in the formation of these small clots and the development of better methods of treatment.

ADVANCES IN HAND SURGERY. Many people injured in accidents frequently require prolonged hospitalization because of serious hand injuries necessitating multiple surgical procedures.

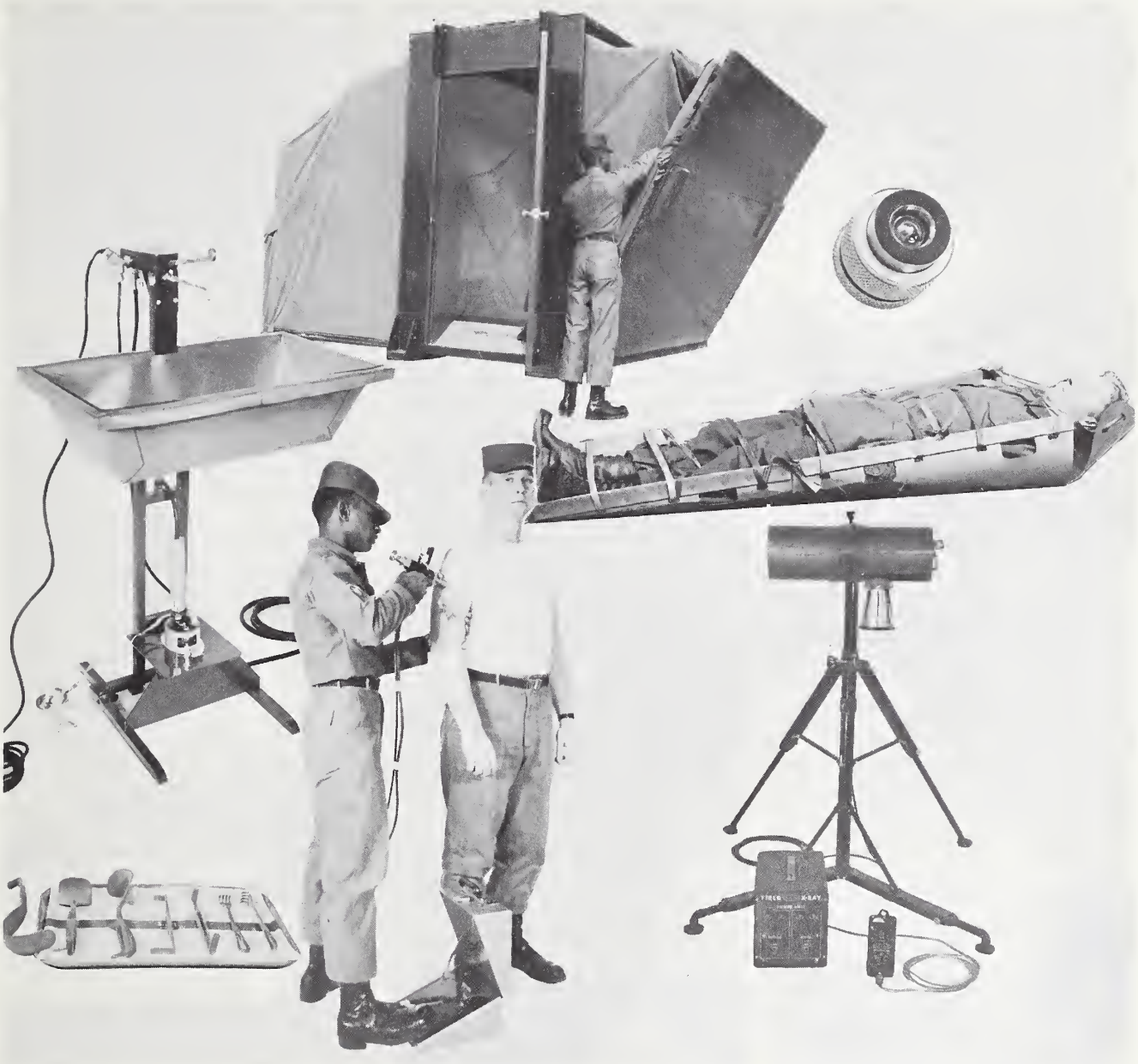
Problems peculiar to wounded soldiers became so serious during World War II and the Korean War that The Surgeon General established special surgical hand centers at various Army hospitals. Due largely to this program, civilian hand surgery has evolved as a specialty.

Many new surgical techniques have been developed over the last decade. Still the tendency to form extensive and binding scar about tendons within the fingers after tendon repair remains one of the most perplexing problems in reconstructive hand surgery. Frequent failure occurs in spite of the best efforts of surgeons.

In recent years this problem of scarring after tendon repair in the fingers has stimulated a great deal of research directed to finding suitable materials for use as "blocking" tubes placed about repaired tendons to prevent adhesions to them.

Such devices have not withstood the test of clinical trial. As part of the Army's continuing vital interest in hand surgery, a comprehensive program to study tendon healing and physiology was begun several years ago at the Walter Reed Army Institute of Research.

Maj Austin D. Potenza has studied the healing processes of finger tendons and the mechanisms of formation of adhesions to them. Using



special surgical techniques he has devised, it has been demonstrated that divided and repaired finger flexor tendons are healed by the cellular activity of surrounding tissues and not by any reparative effort of the tendons themselves.

Further, it has been shown that healing tissues also invade all injured areas on the tendons. Injured areas later become the foci for the formation of adhesions and binding scar. If the tendons are handled by special techniques to exclude further injury, adhesions and scar formation are minimal and functional results are excellent.

Many surgeons have used tubes of various materials about healing tendons to prevent adhesions. Extensive studies at Walter Reed Army Institute of Research have shown that such devices prevent tendon healing and result in more extensive and restrictive scars.

Maj Potenza has shown that small amounts of adhesion formation are necessary for proper healing, and that excess formation can be prevented by use of very delicate and exact technique. He was awarded the Raymond Franklin Metcalf Award by the United States Army Medical Service and the Wellcome Medal by the Association of Military Surgeons of the

(Continued on next page)

MEDICAL EQUIPMENT developed through efforts of the Army Medical Service includes (from top center, counter clockwise); folding box-type container (5′ x 8″ x 10″ when closed), used as a unit for the 400-cycle field X-ray. Field Surgical Scrub Sink consists of aluminum support structure, plastic sump, arm-operated water spigot, electric water heater, and a foot-operated device for dispensing surgical soap. Foot-operated jet injector used for mass immunization. Portable 400-cycle X-ray unit, for use in forward areas. Whole body splint made of waterproof paper board. Intradermal tip, used with jet injector, can dispense vaccines at the rate of approximately 1,400 patients an hour.

United States for this work.

Later research at WRAIR, reported in 1963 by Maj Potenza at the Nov. 4-5-6 meeting of the military section of the American Medical Association, indicates that some of the important tendon surgical techniques in clinical use at present may lead to unsuccessful results. Recommendations for their modification and for development of new techniques have been made.

The most recent tendon research involves tendon grafts. Segments of intact tendons are used to replace damaged or destroyed tendons. Current work with dried tendon grafts from animals is considered promising.

Researchers report that, so far, these appear to be suitable grafts. They can be easily obtained and stored in reserve for long periods of time. This may prove to be an important solution to tendon injury or loss as often occurs in an age of mechanization and rapid travel.

MAN-MACHINE FACTORS. Critical problems concerning man's ability to orient for efficient movement over rough terrain and in low-altitude flying have been under examination at the U.S. Army Medical Research Laboratory, Fort Knox, Ky., since 1954.

A new rotatory stimulator installed and calibrated recently will permit definitive studies of the psychological and physiological responses of man to angular acceleration about the vertical axis.

Test subject prepares for rotatory test, with a push-button in his right hand for signaling rate of return, head fixed with a biting-board and head supports, and electrodes mounted on his face to record eye movements. The capsule canopy will be closed before acceleration. Voice communication and instrumentation signals are led through slip rings to control console in adjoining room.

Under development and construction by the Engineering Experiment Station, Georgia Institute of Technology since 1958, this device will permit angular velocities up to 50 r.p.m. in either direction. The range of angular accelerations extends from .002 to 1.0 radians/sec^2 for both linear and sinusoidal velocity programs.

Important is the capability to accelerate the stimulator through zero velocity without a detectable transient. Its greatest precision is within the range of parameters characteristic of Army air and land vehicles. Although linear acceleration forces up to 1.4 g. are possible, it is not a centrifuge in the usual sense.

The first research project employing the simulator concerns how to reduce or habituate the disturbing and competing vestibular reflexes and disorientation caused by angular acceleration. This habituation or reduction is a desirable byproduct of training for service on any special vehicle, but little is known of the controlling variables.

Current work involves measurement of the reflex movement of the eyes while men make frequent judgment of their rate of turn. Variables under examination are frequency, intensity and duration of rotatory experience and types of associated visual stimulation.

Data being collected have application for prediction of man's capability to orient spatially in modern Army vehicles, and for civilian problems associated with orientation, vision and accelerative forces. Knowledge being acquired is important in driving automobiles and, for example, cranes and construction equipment.

Activities of the Army Medical Research Laboratory result in information and inventions often beneficial to civilian life, such as research on conservation of sight and hearing. Work has resulted in improved optical sighting equipment and the development of range-finding systems.

The protection of hearing has been improved by the invention of a device to use the muscles of the middle ear to reduce the impact of loud noises. The efficiency of this device is in many respects better than the best earplugs and other protectors now in widespread use.

A program to identify the basic skills involved in motor vehicle operation should result in more realistic tests of the ability to operate a vehicle. Studies also were made of the effects on these skills of prolonged vehicle operation. Tests based on these results could measure efficiency after 15 or 20 hours of driving.

Non-verbal communication in man and animals is being studied to determine how information is processed. One aim is to produce a lightweight portable rapid communication system using the skin as a receiver of information. Intended for use by the Army in high-noise areas and other normally difficult communication situations, the system also might apply to improve the lot of the blind and deaf-blind.

MEDICAL EQUIPMENT. Products that facilitate the work of military medics in field hospitals, in combat zones and in remote areas of the world where American fighting men are stationed are attributable in large measure to the Army Medical R&D Laboratory, Fort Totten, N.Y.

Unique is an adjective that fittingly may be applied to the installation, backed by a 41-year history of service to the military services, primarily, but of inestimable value to civilians in numerous major disasters.

Example: Following the devastating earthquake last summer which shattered Skopje, Yugoslavia, an Army medical team used a newly developed jet injection device to immunize victims. Later, the device was employed in Morocco to protect flood victims against typhoid.

The jet injector has been accepted for utilization by the U.S. Public Health Service as well as by the military. Its potential is recognized also for use by schools, health clinics, American Red Cross, U.S. Forestry Service, and the Office of Emergency Planning.

Weighing only three pounds, the vaccine injector is being improved by an intradermal tip now in advanced experimental stage. Its envisioned value is that it may be used for tuberculosis testing and smallpox vaccinations as well as for other vaccines—at the rate of about 1,400 patients an hour, as compared to 30 an hour by the multiple puncture method.

Use of the injector as an anesthesia control device also is under investigation through a modification.

Example: Battlefield X-ray diagnosis to save time that might mean the difference between life and death or prevention of permanent injury for a wounded soldier is an objective toward which Army research has been pointed for many years. The standard X-ray unit used in field hospitals weighs about 1,100 pounds.

Efforts at the Laboratory have con-

tributed to continuing reduction in weight, size and have improved reliability of a portable field X-ray unit though the ultimate goal still presents problems. Value of such a unit in civilian emergencies is obvious.

Development of a disposable whole body splint, fabricated of waterproof paper board, is another Laboratory achievement aimed at battlefield requirements, primarily, but of equal utility under any condition requiring immobilization of a patient with broken bones or internal injuries during movement to the nearest hospital.

Plastic surgical instruments designed for a national emergency when metal is in short supply also have been developed at the Army Medical R&D Lab. Experimental retractors made of polycarbonate resin have withstood replicate steam sterilization at 270° F. without damage.

Research is continuing on polymers that can withstand much higher temperatures. From a time and cost viewpoint, plastic instruments may be formed by injection moulding techniques in minutes at an estimated 1/20th the cost of steel instruments.

Many other examples might be cited to complete the story of contributions of the Laboratory which have been of great benefit for civilian medical service requirements. But let's turn to some of the achievements in the area of medical equipment R&D by the Instrumentation Division of the Walter Reed Army Institute of Research, established 13 years ago.

Exploits of space monkeys Able and Baker served to focus attention on work of the Instrumentation Division, in that they were trained on chairs and equipment made in the Metal-Plastics Department. There Heinz W. Kugler supervises five instrument-makers. Among devices fashioned by that department are instruments to study the endocrine functions of animals under stress.

WRAIR studies of insects have received wide recognition in the field of preventive medicine and require a variety of special equipment—such as an automated system for simulating dawn and dusk for the successful rearing of mosquitos and other disease-carriers.

The Crosby-Kugler Capsule, now in wide use by medical researchers, was developed by the department to permit the sampling, for microscopic and other examination, of tissue from selected points of the digestive tract without risk or discomfort to the patient.

Other equipment for human and animal biopsy has been developed by Dr. Kugler and his associates, such as specialized titration timers for analysis of enzymes, a tensile-strength tester for determining the solidity of healed skin wounds, a skin-thickness gauge for live rats, a light-piped microscope for studying blood vessels in a live diaphragm, and mouth cooler for patients not permitted to drink water.

Devices for freeze-drying medical specimens and for studying the brain through stereotaxic placement of electrodes, as well as the original book-type chromatography rack, have been produced by commercial companies after development by the WRAIR scientists.

Herman M. Hall and three assistants in the Electronics Department produced a transparent constant-temperature stage for the microscope which is becoming widely used in medical zoology. Dr. Irvin Levin, a physical chemist who heads the Division, is also active in the electronics instrument research.

Other creations include a special capsule, with direct-reading meter and recorder, for measuring changes of pressure in the human stomach; various defibrillators and ballistocardiographs for studying cardiac function; and special incubators for tissue-culture work and for transporting and growing bacteria and other fragile microorganisms.

Warren R. Foster, a professional glassblower, heads the Glassblowing Department, which is growing rapidly and is responsible for producing many outstanding pieces of scientific glasswork. Products have included a low-temperature additional funnel for volatile and/or explosive reagents; a 4-still steam-generating unit for the determination of nitrogen, multichambered nuclear radiation flasks for liquid nitrogen; glass-membraned electrodes, and many other intricately fashioned medical research instruments.

Army Medical R&D Command technician takes skin biopsy for diagnosis of onchocerciasis while working with military assistance program on study of tropical diseases and methods of treatment to solve health problems.

AEROMEDICAL RESEARCH. Scientists assigned to the U.S. Army Aeromedical Research Unit at the Army Aviation Center, Fort Rucker, Ala., conduct programed research in the general areas of psychoacoustics, vision, physiology and biochemistry.

The mission of the unit is to provide life sciences research support to Army aviation, and it is becoming known as a focal point for aeromedical consultation services in cooperation with the U.S. Army Hospital at Fort Rucker. The ARU is developing a central repository for literature on aviation medicine.

One area of research of concern to the civilian community is the investigation of hazardous noise environments associated with the operation of U.S. Army aircraft. A survey of the internal and external sound pressure levels of Army aircraft was completed recently with the cooperation and assistance of the School of Aerospace Medicine, Brooks AFB, Tex.

Similarly, data have been collected relative to threshold shifts resulting from noise exposures during firing of weapon systems in armed helicopters. The task was performed in cooperation and consultation with the U.S. Army Medical Research Laboratory at Fort Knox, Ky.

The existence of a medical problem affecting the health of personnel active in Army aviation will be resolved by identification of the high-noise levels involved, measurement under a variety of operational conditions, and recommendations for the acoustical treatment of helicopters.

Findings in this area of research have a direct relation to similar problems in commercial aviation, as pertinent to the design of future aircraft for maximum safety and health.

PREVENTIVE MEDICINE. A contract for development and production of vaccines and preventive measures against diseases prevalent in many lands was initiated in September 1963 when the National Drug Co. Biological R&D Laboratories were dedicated at Swiftwater, Pa.

This new research center is operated under contract with the Office of the Surgeon General, Department of

the Army. NDC president C. M. McAllister mentioned in his dedicatory remarks that in 1896 Army Surgeon General Sternberg influenced a young physician by the name of Richard Slee to establish a laboratory in Swiftwater to produce smallpox vaccine.

"Inspired by his example," Mr. McAllister said, "and wishing to acknowledge his contribution to the health of all people throughout the world, we hereby dedicate our new laboratories to the Military Scientist.

"Assigned to conquer disease and alleviate suffering, he opens new doors to understanding with our neighbors. His laboratories are an arsenal of hope for a safer life to come. His devotion to duty is admired by purposeful men everywhere.

". . . We are dedicating a major research center which was built under a contract proposed by the current Surgeon General to develop vaccines that will protect American soldiers and citizens from infectious diseases in the remote corners of the world."

MEDICAL AID ABROAD. Mercy missions to foreign lands are associated traditionally with the U.S. Army Medical Service. Highly trained teams of Army specialists are providing assistance to many countries as part of the worldwide effort to increase knowledge and methods of treating many diseases little known in the United States, if at all.

Example. An Army Medical R&D Command research mission to Africa is contributing importantly to military knowledge of tropical disease while aiding local governments in the solution of serious health problems.

Since the project was started in July 1959 in the former Belgian Congo, it was moved to Kampala, Uganda. Facilities were provided by the Makerere College Medical School, a part of the University College of East Africa.

Specialists from the Medical R&D Command, including personnel from Walter Reed Army Institute of Research, have been joined by highly skilled personnel of the Armed Forces Institute of Pathology (AFIP) in Washington, D.C. They have supported Makerere College and the Uganda Ministry of Health staffs on disease problems and in teaching medical students and technicians.

Col W. D. Tigertt
WRAIR Commandant

The mission has conducted research on tropical diseases such as onchocerciasis, an infection spread by a worm carried by a small blackfly; subcutaneous phycomycosis, a fungus infection; big spleen disease, a malady of undetermined origin characterized by enlargement of the spleen and liver; endomyocardial fibrosis, a peculiar heart condition of Central Africa; schistosomiasis (bilharzia), a disease caused by a worm which lives in the veins of the mesentery and pelvis; and mycobacterial ulceration.

Pathological specimens have been sent regularly to AFIP in Washington for consultative service, and valuable material has been made available to military and civilian organizations for teaching purposes.

Example. By request of the government of Bolivia, three Army Medical Service personnel were sent as members of a U.S. medical team to provide assistance in efforts to control and eliminate pinta. They worked with the Middle America Research Unit (MARU), an activity financed by the National Institute of Allergy and Infectious Diseases.

Pinta is a centuries-old disease plaguing the population of tropical and Central American countries. Known as "mal de pinto" or "Disease of the Painted Ones," it is characterized by the presence on the skin of colored spots which may be white, coffee colored, blue, red or violet.

One of the areas visited was the

McLester Award Winner Praised as Coauthor of Book

An Army authoriy on nutrition and its relationship to man's physical endurance, C. Frank Consolazio, who received the McLester Award of the Association of Military Surgeons of the United States on Nov. 5, is coauthor of a recently published book receiving general acclaim. Its title is *Physiological Measurements of Metabolic Function in Man.*

Known internationally in his field, Mr. Consolazio is chief of the Bioenergetics Division of the U.S. Army Medical R&DLaboratory,Denver,Colo.

Coauthors of the book are Dr. Robert E. Johnson, professor of physiology at the University of Illinois, and Dr. Louis J. Pecora, director of the Pulmonary Physiology Research Laboratory at the Cincinnati (Ohio) Veterans' Administration Hospital.

Reviews appearing in the *Quarterly Journal of Experimental Physiology and Military Medicine* and other leading publications such as *Lancet* and *Science,* have appraised the book as a significant work of broad value. Some of the typical comments are:

"Some parts of the book will be of value to physicians, others to those interested in ergomanics and personnel research . . . an invaluable aid to planning courses in human physiology for medical students."

"Detailed descriptions with diagrams are given of the common types of equipment and there are many useful, practical tips for their use. . . . The necessary calculations are explained with care and detail and there are a large number of reference data . . . invaluable, authoritative and time-saving to the researcher in metabolism and physiology."

Sections of the book include: Respiratory Metabolism; Analysis of the Respiratory Gases; Physical Chemistry of the Blood Gases; Measurement of Pulmonary Function; Body Composition and Measurement; Computation of Metabolic Balances; Physical Fitness and Performance; Methods for Testing Physical Fitness; Heat Balance; Limits of Variability of Physiological Measurements.

C. Frank Consolazio

Alto Beni Region at the headwaters of the Amazon River, an area the Bolivian government is trying to colonize, but which prospective colonists are reluctant to enter because of the fear of contracting pinta.

Residents were studied clinically and blood specimens were taken for serolgic studies. Examinations were made for laboratory evidence of other infectious diseases, and they were treated with appropriate drugs for elimination of treponeme infection.

Investigation was designed to establish clinical and laboratory diagnosis of pinta. About 150 patients were treated and some 600 blood specimens and biological materials procured.

As a result of the studies, an estimate is expected of the prevalence and epidemiology of various parasitic and tropic diseases in the region which will be of great value to the Brazilian government.

Numerous other examples of U.S. Army Medical Service activities in foreign lands might be presented to substantiate the continuing story of how Army research is helping civilians in all parts of the world.

HumRRO Research Unit Redesignated, Mission Changed

Redesignation of the U.S. Army Leadership Human Research Unit at the Presidio of Monterey, Calif., in November, also changed its mission.

Under the name of the U.S. Army Training Center Human Research Unit, the field laboratory established in 1952 is assigned responsibility for developing new approaches to basic training and management at Army training centers.

The Unit is one of five joint U.S. Continental Army Command-Human Resources Research Office field laboratories engaged in human factors research and development in Army training, motivation and leadership.

Technical direction of the R&D efforts of these laboratories is the responsibility of the Human Resources Research Office (HumRRO) of the George Washington University, Washington, D.C.

HumRRO has consolidated all of its R&D efforts on the Basic Individual Training-Advanced Individual Training cycle at the Training Center (HRU). Several leadership training activities have been transferred to the U.S. Army Infantry HRU at Fort Benning, Ga.

The Training Center HRU will work closely with Fort Ord Army Training Center on problems related to the indoctrination and training of the new soldier. Tasks SWINGSHIFT and RIFLEMAN have been transferred to the Training Center HRU from the U.S. Army Infantry HRU at Fort Benning, Ga.

Directed by Dr. Thomas Nichols, Task SWINGSHIFT is concerned with improvement of the individual soldier's effectiveness in infantry operations during periods of limited visibility. RIFLEMAN, directed by Dr. Joseph Ward, seeks greater combat proficiency in using light weapons.

HumRRO has completed 10 tasks concerned with Basic Combat Training — Advanced Individual Training (BCT-AIT) cycles. The consolidation of effort at the Training Center HRU marks the beginning of a large-scale program to improve the overall effectiveness of initial training.

Dr. John E. Taylor is director of research at the Training Center and Lt Col R. H. McClay is unit chief.

Dr. Hilton Bialek, formerly an adviser for program development in the office of the HumRRO director, is assigned to the Monterey Unit to serve as leader of Task CENTER. This is a new study of the motivation of the recruit as he begins basic training.

Osler's Master-word

I propose to tell you the secret of life as I have seen the game played, and as I have tried to play it myself. You remember in one of the Jungle Stories that when Mowgli wished to be avenged on the villagers he could only get the help of Hathi and his sons by sending them the master-word. This I propose to give you in the hope, yes, in the full assurance, that some of you at least will lay hold upon it to your profit. Though a little one, the master-word looms large in meaning. It is the open sesame to every portal, the great equalizer in the world, the true philosopher's stone, which transmutes all the base metal of humanity into gold. The stupid man among you it will make bright, the bright man brilliant, and the brilliant student steady. With the magic word in your heart all things are possible, and without it all study is vanity and vexation. The miracles of life are with it; the blind see by touch, the deaf hear with eyes, the dumb speak with fingers. To the youth it brings hope, to the middle-aged confidence, to the aged repose. True balm of hurt minds, in its presence the heart of the sorrowful is lightened and consoled. It is directly responsible for all advances in medicine during the past twenty-five centuries. Laying hold upon it Hippocrates made observation and science the warp and woof of our art. Galen so read its meaning that fifteen centuries stopped thinking, and slept until awakened by the De Fabrica of Vesalius, which is the very incarnation of the master-word. With its inspiration Harvey gave an impulse to a larger circulation than he wot of, an impulse which we feel to-day. Hunter sounded all its heights and depths, and stands out in our history as one of the great exemplars of its virtue. With it Virchow smote the rock, and the waters of progress gushed out; while in the hands of Pasteur it proved a very talisman to open to us a new heaven in medicine and a new earth in surgery. Not only has it been the touchstone of progress, but it is the measure of success in every-day life. Not a man before you but is beholden to it for his position here, while he who addresses you has that honour directly in consequence of having had it graven on his heart when he was as you are to-day. And the master-word is *Work*, a little one, as I have said, but fraught with momentous sequences if you can but write it on the tablets of your hearts, and bind it upon your foreheads.—Sir William Osler: *Aequanimitas, With Other Addresses to Medical Students, Nurses, and Practitioners of Medicine*, Third ed. reprinted, H. K. Lewis and Co., London 1948, pp. 356-357. (Reprinted from *Annals of Internal Medicine*, Nov. 1963.)

Picatinny Arsenal Sets Up Office to Manage Projects

One of the results of the recent reorganization of the U.S. Army Munitions Command is that Picatinny Arsenal will shoulder more responsibility in providing the soldier with new and better ammunition.

In support of this added responsibility, a new Commodity Management Office at Picatinny is handling certain high-interest projects involving both nuclear and conventional ammunition.

Examples of such projects are rockets, demolition devices, artillery ammunition, and warhead sections for guided missiles.

The new office, staffed initially by about 30 hand-picked people, is headed up by Lt Col Guy H. Drewry (no relation to a former commander of Picatinny) with Fred Santucci as deputy chief and technical director.

U.S. Army Biological Laboratories Activities Directed To National Defense Goals Yield Byproduct Benefits

The Nation's research and development activities in biological agents, weapons and defenses are centered largely at the U.S. Army Biological Laboratories, Fort Detrick, Md.

Fort Detrick was activated Apr. 20, 1943, shortly after Allied intelligence verified that some of the Axis powers were investigating the potential of biological weapons. The United States never employed biological weapons in or after World War II.

Still when it became known that various major powers were conducting extensive military biological research and development programs that originated during or prior to that war, the United States judged the continuation of its own biological program to be in the best interests of national defense.

Today, Fort Detrick's primary mission is the investigation of biological agents and weapons, and defenses against such weapons. Successful fulfillment of this mission requires a diversified research program in the science and technology of disciplines ranging from aerobiology to zoology. Included are the physical sciences.

Talents of many well-trained biological and physical scientists, medical doctors, engineers, and scientific administrators provide the Bio-Labs with a strong in-house research capability. Approximately 320 B.S., 110 M.S., 120 Ph. D., 34 D.V.M., and 14 M.D. degrees representing more than 45 disciplines are held by the staff.

Many of these personnel serve on the editorial advisory boards of professional publications and as officers of regional, national and international professional societies. Annually, staff members make numerous presentations at national and international society meetings, at worldwide biological and medical conferences, and at academic institutions.

Each year about 100 manuscripts authored by staff members are submitted for publication in professional journals. The acceptance rate for these manuscripts averages more than 90 percent, considerably better than the national average.

Because the research program is so broad in scope, the closest possible relationship also is maintained with research facilities of universities, industries and Government agencies in the United States and throughout the Free World. Noted specialists from all parts of the world are numbered among the consultants who provide the program with the benefit of their knowledge and experience.

Out of the current research program, and earlier ones, have come not only major contributions to the Nation's defense, but also substantial contributions to scientific progress and human welfare. Much of the information regarding the former is, of course, classified, but contributions of the latter type can be described.

One area of effort at Fort Detrick is devoted to the development or improvement of safe and effective vaccines and toxoids against various human diseases.

In 1955, Dr. George G. Wright was awarded the Army's Exceptional Civilian Service Award for development of "the first nonliving anthrax vaccine clinically acceptable for tests in humans." Subsequent extensive field evaluation of this vaccine in exposed susceptible populations showed it to be 92.5 percent effective.

During the course of the field evaluations, Dr. Milton Puziss, a colleague of Dr. Wright's, developed an improved method for producing the vaccine based on anaerobic, deep fermentation. This improved method also proved applicable to scale-up for commercial manufacture. Quantities of the improved vaccine produced commercially currently are being evaluated in volunteer textile mill workers in the U.S.

Results are not yet complete. Preliminary indications are that the vaccine may not only provide better protection but also make possible a shorter vaccination schedule. In 1962, Dr. Puziss was presented an Army Research and Development Achievement Award recognizing his work.

The pentavalent botulinum toxoid developed at Fort Detrick has proved very effective, and it is made available to other researchers throughout the world who are investigating botulism. Investigations of vaccine prophylaxis against tularemia in man resulted in the development of an innocuous, improved, highly immunogenic, live vaccine. Considerable information was obtained regarding the comparative protection afforded by dermal and aerogenic vaccination.

Unique equipment and methods for the study of mirobiological aerosols have been perfected at the Bio-Labs and made available for medical research. To provide both versatility and flexibility in aerosol evaluation, a variety of sizes of cloud chambers have been developed. The smallest of these are tanks with total volumes of 6,200 liters. The largest facility is a one-million-liter sphere constructed

Col Carl S. Casto, Fort Detrick commanding officer since August 1960 . . . Ohio State University graduate with chemical engineering degree . . . 2 years post-graduate study at Harvard University School of Business . . . graduate of Command and General Staff College, Armed Forces Staff College, and Army War College . . . decorations include Legion of Merit and Army Commendation Ribbon with two Oak Leaf Clusters.

Frederick Orchestra Honors Army BioLabs Commander

U.S. Army Biological Laboratories Commander Col Carl S. Casto, who will retire from Army active duty in March 1964, was honored recently for his "ardent support" of the Frederick (Md.) Community Orchestra.

The organization dedicated its first concert of the winter season to him as a special tribute. He was recognized for his support by presentation of an oil painting of his Fort Detrick (Md.) home and a parchment scroll signed by all orchestra members.

Carroll H. Hendrickson, Jr., chairman of the board of the orchestra, made the presentation, stating:

"Col Casto, as one of the founding members of the orchestra, has given enthusiastic support to the group. Through his encouragement, a number of Fort Detrick personnel participate as musicians, or in other capacities which have contributed much to the success now enjoyed by our organization.

"During his stay in the Frederick area, Col Casto has contributed greatly to both the cultural and civic life of the community."

of mild steel 1¼ inches thick.

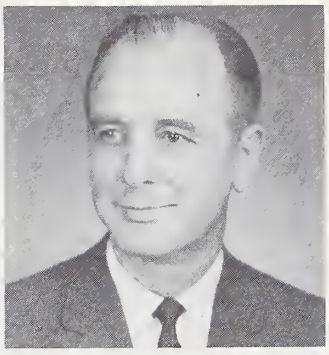
Other facilities include 50,000-, 100,000,- and 850,000-liter test chambers. Investigations with such equipment and methods have added much to knowledge of the conditions and mechanisms of action of natural respiratory infection.

Because of their peculiar characteristics, many items of biological laboratory equipment and material are damaged, destroyed, or only ineffectively sterilized by standard methods such as steam, dry heat and liquid chemicals. As a result of 15 years research in biological sterilization, Fort Detrick scientists proved the efficacy of two gaseous sterilizers.

Information concerning the bactericidal properties of ethylene oxide was "rediscovered" and subsequently disseminated widely. Methods and inexpensive mobile equipment were developed to use with ethylene oxide in the biological sterilization of material ranging from delicate laboratory equipment to rugged "6 x 6" Army trucks. Experimentation continues in the utilization of ethylene oxide as a biological sterilizer for interplanetary space vehicles.

The second gaseous sterilizer, beta-propiolactone, had been used by other workers in aqueous solutions. Fort Detrick scientists were the first to investigate and demonstrate its sterilizing potential in gaseous form. It acts less rapidly and is not as penetrating as ethylene oxide, but other advantageous characteristics make beta-propiolactone particularly well-suited for large-area sterilization. It has been used successfully to sterilize such large areas as a 2-story Army barracks, a furnished hospital dayroom, an Army hospital ward, and an animal housing room.

A continuing research program, now in its eighth year, has been conducted to obtain data as a guide in developing, designing, and testing ultra violet installations suitable for use in an infectious disease laboratory. Primary emphasis is on laboratory personnel protection and the micro-organic isolation of exposed experimental animals to prevent cross-contamination.



Dr. Riley D. Housewright, Fort Detrick scientific director since 1956 . . . graduate of North Texas State College with B.S. in biology, M.A. in bacteriology from University of Chicago, Ph. D. in bacteriology from University of Chicago . . . post-graduate work at Department of Agriculture Graduate School and at Cambridge University, England . . . organization memberships include American Society for Microbiology, Society for Experimental Biology and Medicine, Society for General Microbiology (England), and the AAAS . . . Charter Fellow of American Academy of Microbiology, Fellow of N. Y. Academy of Sciences.

The program has generated much information on UV sterilization of large volumes of air, UV effects on laboratory personnel, and maintenance of UV installations.

Operating standards and improved designs for UV installations for air locks, doorways, walk-in incubators, and laboratories were developed. Some unique UV installations also were designed and developed, including a small pass-through chamber for bulkier objects, a sterilizer for small volumes of air, a portable UV floodlight, UV-protected animal cage racks, and an installation to minimize contamination from soiled laboratory clothing placed in laundry discard bags prior to autoclaving.

A comprehensive report covering the UV research program, including the results of an extensive literature survey, is available from the Armed Forces Technical Information Agency and the Office of Technical Services, Department of Commerce. The report is titled "Microbiological Applications of Ultraviolet Radiations."

In 1949 Fort Detrick contracted with the Public Health Service for the production of six microbiological safety film strips and one movie. Completed copies of these films were placed with the Public Health Service's film loan service in 1951. In the following eight years, the strips and the movie were shown 5,239 times to a total audience of 225,277. The movie, "Infectious Hazards of Bacteriological Techniques," was shown 735 times.

Institutions requesting the movie included 414 colleges and universities, 195 hospitals, professional and independent organizations, 66 state and local agencies such as health departments, 24 Federal Public Health Service groups, 18 Armed Services groups, 15 other Federal agencies, and 3 foreign countries. The film strips and movie are still available from the U.S. Public Health Service.

A recently completed, year-long survey of 108 microbiological laboratories in 18 countries (9 Australian, 5 Canadian, 71 European, 1 Japanese, and 22 U.S.) indicated that the U.S. Army Biological Laboratories is the world leader in microbiological laboratory safety. Of the 108 laboratories surveyed, only four were considered to be completely adequate and sufficiently proficient in all aspects of microbiological safety.

The report resulting from the survey recommended that, to the greatest degree possible commensurate with its other responsibilities, the Bio-Labs make available the results of the microbiological safety program to all groups engaged in similar research in the interest of worldwide microbiological laboratory safety.

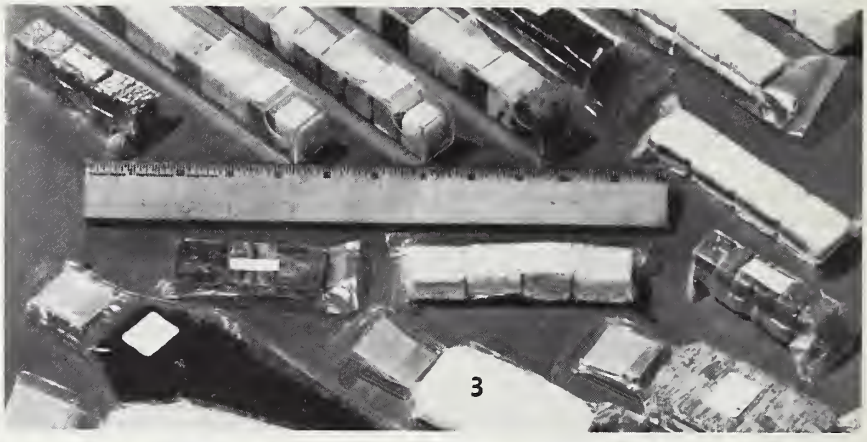
The report, "Microbiological Safety in U.S. and Foreign Laboratories," has been cleared by the Department of Defense for release to the general public. Nongovernmental agencies and individuals will be able to purchase the report from the Library of Congress, Photo-Duplication Services, Publication Board Projects, Washington 25, D.C.

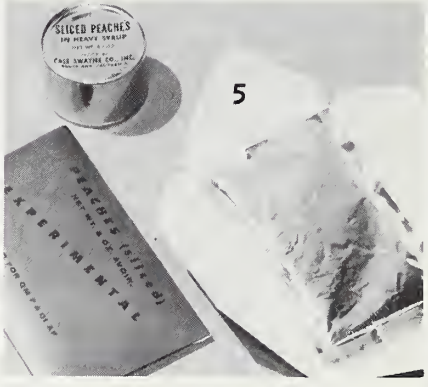
Fort Detrick staff members were instrumental in arranging for the development and mass production in this country of the membrane filter, originally developed in Germany

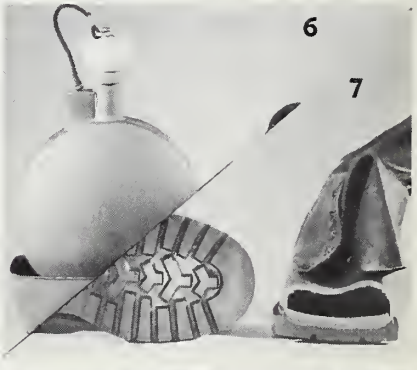
(Continued on page 39)

Dr. LeRoy D. Fothergill, Fort Detrick scientific advisor since 1962 . . . associated with military biological R&D program for past 20 years . . . graduate of University of Nevada and Harvard University Medical School . . . member of American Association of Immunologists, American Public Health Association, and American Society for Microbiology . . . awarded (1962) the Army's highest civilian award, the Exceptional Civilian Service Award, for "dynamic leadership as scientific advisor for the Biological R&D Program."

U.S. Army Natick Laboratories R&D Results Illustrate Broad Range of Byproducts Applied to Civil Needs







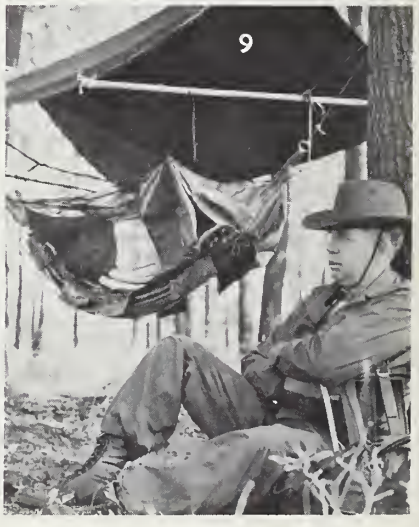


Fig 1, FOAM-IN-PLACE SHELTER. Foam material is also used for packing, insulation and life preservers. Fig. 2, ALL-WEATHER CLOTHING. Shown are thermalibrium suit, arctic parka, jungle warfare garments. Fig. 3, BITE-SIZE AND DEHYDRATED FOODS for space travelers. Fig. 4, WATER REPELLENT FORMULATION for combat clothing. Fig. 5, FLEXIBLE PACKAGING saves space while facilitating handling. Fig. 6, STAINLESS STEEL VACUUM CANTEEN keeps liquids from freezing at extreme low temperatures. Fig. 7, DIRECT-MOLDED SOLE for footwear. Fig. 8, FOODS preserved by gamma rays. Fig. 9, LIGHTWEIGHT tentage, sleeping gear, packframes and knapsacks.

A durable water-repellent treatment for rainwear, a variety of freeze-dehydrated foods, an insulated rubber boot for hunters and outdoorsmen—each is a part of the pattern of everyday living. All are an outgrowth of military research and development or related programs in which the U.S. Army had a guiding or participating interest.

The rain-shedding formulation was developed for combat clothing. The insulated rubber boot, designed for extreme cold temperatures, was worn with only one pair of socks by Army personnel and others conducting studies during the International Geophysical Year in the Antarctic. An improved technique of freeze drying, through which processing time was considerably reduced, is one of several food preservation techniques developed the Army Food Program.

Developments at the U.S. Army Natick (Mass.) Laboratories, where many Government career scientists and technicians provide a widely respected in-house research capability, have touched upon many industries providing commodities and services for the American public. Among those in use or having future commercial application are:

- Various techniques for the preservation of foods by dehydration which reduce bulk and weight.
- Preservation processing by ionizing radiation for longer shelf life and increased availability of fresh foods in remote areas.
- A highly nutritious cracker, part of emergency fallout shelter rations.
- New packaging and packing methods, and moisture-barrier materials such as foils, films and treated papers used in the food industry.
- Bite-size sandwiches and other special foods for astronauts.
- A direct-molded sole for footwear, a process which vulcanizes the entire outsole and heel directly to the upper. (Army durability, sizing and comfort studies are providing valuable data to commercial developers of this technique.)
- A thermal-insulated rubber boot for extremely cold weather.
- Lightweight cold weather clothing permitting freedom of movement.
- A water-and-oil repellent treatment for textiles (Quarpel), which resists removal during laundering of dry cleaning.
- Foam-in-place plastics for temporary shelters, insulation, packing materials, life preservers and jackets —a result of military-industry research and development.
- Bedding and bunking facilities for fallout shelters.
- An effective insect repellent now in commercial production in an aerosol spray, liquid, stick, and impregnated into a disposable paper towel.
- A stainless steel vacuum canteen which keeps liquids from freezing at extremely low temperatures.
- Precooked, dehydrated, "quick-serve" meals prepared in their own containers by adding hot/cold water.
- A synthetic rubber which possesses the best combination of low-temperature flexibility, fuel-resistance and flame retardance of known rubbers.
- A chemical composition which preserves and sterilizes feathers against microbiological attack and loss of filling power even after prolonged storage and repeated wettings.
- Eyeshields, gloves and double material reflective camouflage covering to lessen exposure to thermal effects of nuclear devices.
- Tentage supported entirely by air from blowers without the use of poles or other accessories. (Military evaluation and testing of coated fabrics and air-generating equipment are aiding in the commercial design of this novel shelter system.)
- Improved body armor resulting from research in metal alloys, ceramics, plastics and textile fibers. (This may be used by law-enforcement officers, money-handling personnel in transport services, and others.)
- A sleeping bag with accessories comfortable in temperatures to —65°.
- Instruments with automated features which "measure" color in textile fabrics, thereby providing information to insure color uniformity in stock from different manufacturers.
- Improved fungicides and germicides (end products of military-industry investigations and evaluation).

End products of R&D at the U.S. Army Natick Laboratories here listed reflect only a portion of significant achievements that have touched the daily life of people throughout the United States and foreign lands.

American manufacturers have benefitted on a global scale through export sales of many of the products. As a Massachusetts firm representative said recently, "Military research is helping to build a reputation for American quality. Benefits contribute to our worldwide image."

Panel Scheduled on Clinical Research, Medicine

Clinical research and its relationship to clinical medicine and basic research is the subject selected for a panel discussion scheduled Jan. 7 at the Army's Walter Reed General Hospital in Washington, D.C.

Among well-known leaders slated to take part in the session, to be held in Conference Room No. 1 at 7:30 p.m., are Dr. Thomas A. Warthin and Dr. Theodore E. Woodward.

Dr. Warthin is chief of Medical Service, Veterans Administration Hospital, West Roxbury, Mass., an assistant clinical professor at Harvard Medical School and a consultant to the Army Surgeon General. Dr. Woodward is professor and chairman, Department of Medicine, University of Maryland School of Medicine, and a consultant to Walter Reed Army Institute of Research,Washington,D.C.

The panel will be moderated by Col Frederic J. Hughes, MC, director of Professional Service, Office of the Army Surgeon General.

Clinical research is recognized, in essence, as the spearhead of medical progress in that it performs the dual function of testing and delivering the products of basic research to the clinician and posing clinical problems to basic researchers for solution.

Since World War II, clinical research has become an integral part of the teaching and training programs at university medical centers as well as for clinical application and testing of products of basic science.

The U.S. Army Medical Service occupies a unique position in its assigned mission to develop and apply methods designed to maintain a low noneffective (not physically operational) rate among military personnel.

In accomplishment of that mission, the Army Medical Service must integrate its training and research programs for the immediate and ultimate protection and treatment of U.S. Army personnel, since many agencies have independently evolved and implemented related policies.

The Jan. 7 panel discussion is intended to stimulate free discussion from the floor, permit clarification of problems and an approach to them, and lead to a unified Medical Service research and training program.

GIMRADA Contributes to Advanced Mapping Techniques

Anyone planning to write a book titled "Mapping Made Easy" might spin his wheels for a long time looking for a better source of basic knowledge than the U.S. Army Corps of Engineers Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.

Mapping methodology has been facilitated almost incredibly by scientific advances in recent years, and GIMRADA has figured prominently in the progress.

Labor-saving, time-cutting, dollar-stretching techniques developed by the Agency for military requirements are no less important to many mapping and geodesy problems with which civilian scientists and engineers are grappling.

Army emphasis in surveying and geodesy, as related to research, development, design and testing of systems, is focused on combat operations, military mapping, peacetime mapping on a worldwide basis, and satellite tracking equipment for geodetic purposes.

One of the greatest breakthroughs in the R&D program for surveying and geodesy in many years came with the development of indirect-measuring equipment, such as the geodimeter, which uses light waves as the measuring medium, and the tellurometer, which uses radio waves.

Although both items were developed by foreign firms, GIMRADA was first to recognize the importance of these new techniques and to introduce the equipment in this country. Through a cooperative R&D program with the foreign manufacturers, improved equipment was developed.

Lightweight Gyro-Azimuth Theodolite.

The tellurometer and geodimeter employ the principle of propogating microwaves or light, respectively, between two stations. Since electromagnetic propagation velocity is a constant, the time lapse is readily convertible to range or distance.

This equipment can be used to (1) insert baselines where it would be impossible employing conventional taping methods; (2) in trilateration where all sides of a geometric figure are measured, and (3) to check adjusted triangulation lines to determine any distortions that may have been introduced in rigid adjustment.

Private users with unusual survey problems estimate time reductions of about 30 percent in good terrain conditions and up to 200 percent in mountainous areas.

One state highway department, for example, reported a saving of $100,000 a year for just one of these new tools, plus an added advantage of a substantial increase in accuracy.

In many instances, 2nd order surveys can be run at lower cost than using previous 3rd order methods, and, in many applications, these new methods largely replace expensive triangulation and tape-traverses.

In the inertial field, rapid advances in precision gyroscopes have provided a new surveying tool. A large field-size gyro-azimuth theodolite was developed and now is in the hands of troops to give an all-weather independent capability for azimuth work.

The principle used is the dynamic characteristics of a precision gyroscope in conjunction with earth rotation to provide a north reference for theodolite. This instrument was the forerunner of a new development, now in progress, for a portable, lightweight instrument of the same accuracy but which can be produced in quantity for about one-third the cost.

This lightweight gyro-azimuth theodolite should be of interest to land management programs, mining, geologic exploration, tunnel work, air lines for calibration and checkout of aircraft navigation equipment in the hangar (rather than inconvenience of special calibration area set-up now in use), and where strong local magnetic attraction make the ordinary compass useless.

Through years of R&D effort and interest generated by the U.S. Army Corps of Engineers, the first domestic production contract since World War II is underway for optical reading theodolites.

Other areas of GIMRADA R&D effort under the direction of Col W. H. Van Atta include electronic surveying equipment, utilization of geodetic satellites for surveying, long-range survey systems, application of Lasers and Masers, electronic angle measuring, more portable gyro compasses, inertial survey systems, and application of many other new techniques in surveying, geodesy and mapping.

7.62 mm. Ammo Linking Machine Set for Production

Development of the first field type power-driven machine for linking or delinking the NATO standard 7.62 mm. small arms ammunition was announced recently by the Tooele Army Depot. The new machine is ready for production and is awaiting orders from CONUS and overseas activities.

The unit is portable, uses 110/220 volts, and production models will cost $3,500 or less. Filling a void between high-speed factory equipment and hand operation, it is designed for use at depot and station levels where its production rate of 330 rounds per minute, linking or delinking, is adequate.

The unit utilizes a 3-chute feeder arrangement to permit any desired mix of linked ammunition. Special cams allow simultaneous insertion and removal of individual cartridges in any desired combination.

Release of this new piece of field equipment is scheduled to meet the high priority requirements in U.S. depots and stations as well as in each of the other NATO countries.

Joseph Palmer (left) and Jay Wilson, equipment designers who did basic research, developed specifications and performed evaluation tests, demonstrate 7.62mm. linking and delinking machine at Toole Army Depot.

The Army Orange Spectrometer

By E. R. Thilo, Director
Physics Research Laboratory
Pitman-Dunn Institute for Research

The orange spectrometer is an instrument used primarily to measure, with high efficiency at moderate resolution, the energy and intensity distribution of fast electrons. This beta-ray instrument has six electromagnetic focusing gaps, each in the shape of a sector of a sphere and arranged much like sections of an orange.

In November 1959, Dr. Eugene L. Church of the U.S. Army Frankford Arsenal at Philadelphia, Pa., was awarded a Secretary of the Army Research and Study Fellowship for study and work at the Bohr Institute in Copenhagen, Denmark. While there, he used the Orange Beta-ray Spectrometer which was designed and constructed at the Institute.

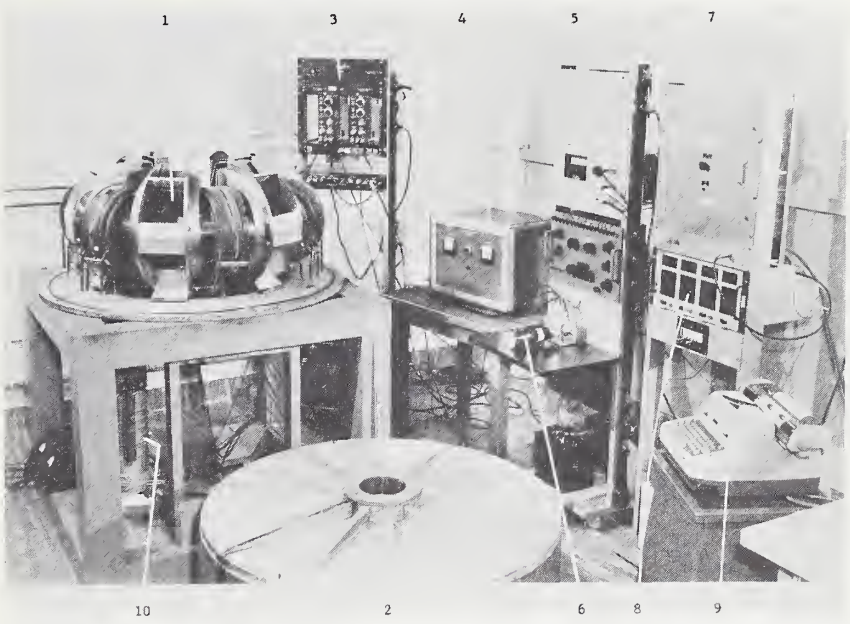
Experience with this instrument prompted him to propose the construction of a similar one for his use in the United States. With funds obtained through a U.S. Army Research Office proposal and transferred to Army Ordnance Industrial Center, Europe, three contracts were awarded for the manufacture of the major components. Dr. Church served as technical adviser on these contracts.

The crated parts arrived in November 1961 and were trucked to Brookhaven National Laboratory, where Dr. Church is an employee of the Pitman-Dunn Institute for Research of Frankford Arsenal.

Assembled, outfitted and automated at Brookhaven in 1962, the facility is the first Orange Beta-ray Spectrometer of the Copenhagen design placed in operation in the U.S. Being used for a variety of research projects involving Department of the Army and Brookhaven personnel, it represents a total investment of roughly $40,000. Only one-eighth was spent for spectrometer components.

The orange spectrometer is a versatile instrument that may be used in a number of diverse fields with slight modification. Immediate uses are: chemistry — investigation of the primary charge distribution in fission; solid state—investigation of the Mossbauer effect; nuclear physics — investigation of the nuclear decoy modes and nuclear structure; instrumentation—prototype for other spectrometers, such as copies for other institutions, smaller versions for medical and nuclear reaction studies.

Other uses include: applied nuclear physics — investigation of the transmission and scattering of electrons by thin foils; reactor physics—investigation of gamma rays following neutron capture; nuclear reactions—investigation of direct reactions using accelerator beams.



Orange Beta-Ray Spectrometer components—1) orange spectrometer, 2) lid vacuum tank, 3) electronics for beta and ohmma counters, 4) current supply, 5) monitoring equipment, 6) gamma-ray counter assembly, 7) spectrometer automation programer, 8) scaler for visual readout of data, 9) electric typewriter for automatic printout of data, 10) pump system.

The facility has stimulated inquiries from universities and research organizations concerning its operation, and seeking information on the acquisition of similar equipment.

Professor Tor Ragnar Gerholm of the University of Stockholm studied with Dr. Church the past summer (1963) setting up a cooperative experiment on the instrument. Noted scientists in many countries have sought Dr. Church's advice in using this device to seek data previously unobtainable in nuclear phenomena.

Army BioLabs Activities Yield Byproduct Benefits

(Continued from page 35)

prior to and during World War II. It has been estimated that use of this filter in water analysis alone in the United States can result in an annual national savings of $43,000,000.

Scientific capabilities of the BioLabs are enhanced by more than 50 enlisted scientific and professional personnel stationed at Fort Detrick. Collectively, they hold 12 B.A., 40 B.S., and 2 M.S. degrees. Sp/4 Ira C. Felkner copped the top individual prize of $500 at the 1962 Army Science Conference for his paper on "DNA Isolation by an Improved Procedure for Transformation of Bacillus sp."

Outstanding among 35 women scientists and professional personnel is Dr. Dorothy G. Smith, assistant director of Biological Research. She was awarded a Certificate for Meritorious Civilian Service in 1961 and also was an Army nominee for the 1962 Federal Women's Award.

Dr. Smith is the author or coauthor of 29 publications on various microbiological subjects and is a Charter Fellow of the American Academy of Microbiology. Her areas of interest include experimental therapy of infectious diseases and the therapeutic activity of existing and newly discovered antibiotics and chemotherapeutic agents.

The Fort Detrick staff is proud of but never content with its contributions to scientific progress and human welfare and to the national defense, for which it assumes primary responsibility in the biological field.

Chemical R&D Labs List Impressive Record of 'Bonus Benefits'

Activities in the U.S. Army Chemical Research and Development Laboratories at Edgewood Arsenal, Md., encompass a broad range of investigations important to the military, by intent, but often, by chance, of vast value in serving civilian requirements.

Research at CRDL deals with chemistry, medicine, pharmocology, psychology, physiology and related scientific and engineering disciplines. Methods, processes and devices resulting from that effort have served the military, as intended, and found application in industry, medicine and agriculture.

Example. One aspect of CRDL research is concerned with a group of toxic chemical compounds called nerve agents that can act upon combat forces or civilian communities to achieve a military objective—that is, temporarily immobilize the enemy.

Similar in composition to various commercial insecticides and agricultural chemicals in more or less common use, the nerve agents may be used to paralyze nerve centers, particularly those that control breathing.

Col Wm. G. Willmann
CRDL Commanding Officer

The mouth-to-mouth resuscitation technique now used almost universally resulted from study of effects of nerve agents and how to revive more easily those patients suffering from effects. A further refinement was the mask-to-mask resuscitator, enabling rescuer and patient to remain masked during the process.

CRDL research on nerve agents also has yielded a great amount of information on precautionary and protective measures that have found common use in agriculture to safeguard farmers and others working with the powerful new insecticides.

Less toxic than nerve agents, the insecticides are similarly constituted and dangerous if used without proper precautions. Treatment and decontamination methods devised by CRDL are being used to protect workers in factories producing insecticides, as well as those who load and fly aircraft used in crop dusting operations.

Therapeutic Applications. In working with DFP, a chemical compound similar in effect to the nerve agents, CRDL and university scientists found that it had certain properties useful in treating glaucoma, a serious eye disease. Glaucoma develops pressure in the eyeball, causing marked impairment of vision. Unless this pressure is relieved, total blindness often results. Because of its action in alleviating this pressure for prolonged periods of time, DFP has become one of the most successful treatments.

Similarly, an otherwise tragic accident led to the eventual discovery that some of the mustard agents were useful in treating certain forms of cancer.

During World War II, a ship loaded with liquid mustard exploded while anchored in the harbor of Bari, Italy. The released liquid agent became mixed with fuel oil and floated on the surface of the water. Victims were found during treatment to have experienced a reduction in white blood corpuscles.

Tests conducted later at CRDL confirmed that exposure to mustard had caused this reaction in the blood. The intriguing idea was raised that certain of these agents might be used to treat diseases characterized by an abnormal increase in white blood cells. Subsequently, medical researchers used mustard-type agents to treat leukemia, Hodgkins disease and lymphosarcoma, with varying success.

Medical officers emphasize that these compounds do not cure any form of cancer, but they have been found to prolong life in many instances and to bring about remarkable remissions in others.

Protection of Goods. Methods for protecting stored food, fabrics and clothing from insect pests were formulated as a result of entomological experiments conducted by CRDL in conjunction with the Brookhaven National Laboratory. Methods involve treating both raw and packaged foods with radiation from reactor wastes and other sources. The techniques have been particularly successful with packaged goods, since reinfestation does not occur.

By applying this same basic idea in a somewhat different manner, the U.S. Department of Agriculture was successful in eliminating the screwworm fly as a serious cattle pest in Florida.

Dr. Herbert Lipke

Dugway Microbiologist Joins 'Gallery of Noted Mycologists'

Dr. Geoffery F. Orr, a microbiologist employed at the Dugway (Utah) Proving Ground Biological Laboratories, was named recently to the "Gallery of Contemporary Noted Mycologists" by the *Mycopathologia et Mycologia Applicata,* an internationally known publication devoted to the study of mycology.

Dr. Orr arrived at Dugway early this year after serving as consulting mycologist to the U.S. Public Health Service Kansas City Field Station of the Communicable Disease Center. Mycology is that branch of botany which deals with the fungi.

Prior to his employment there, he was a teaching and research assistant at the University of California, Los Angeles, where he received both his masters and doctorate degrees in botanical science.

A veteran of the U.S. Army Air Corps, Dr. Orr served as an aviation crew chief from 1943 to 1946 in the Southwest Pacific Theater. At the conclusion of World War II, he entered California State Polytechnic College at Santa Monica where he earned a degree in horticulture.

Dr. Orr is a member of the Mycological Society of America, the American Society of Plant Toxonomists and Sigma Xi, the honorary science and engineering fraternity.

Benefits to Agriculture. Some chemical compounds and devices, developed originally for military use, have helped farmers, food processors and shippers to cut production and transportation losses.

Chloropicrin, one of the original chemical agents, is used in greenhouses and fields to control soil-borne fungi and bacteria. It is also useful in exterminating insects and rodents in mills, granaries, warehouses and ships.

Another CRDL compound has been employed specifically to destroy dandelions and other broadleafed weeds. One known simply as 1080 has been used by many householders to rid their premises of rodents.

The same type of mechanical smoke generator used by the Army as a battlefield screening device has protected many fruit crops in the United States. When freezing threatens, this generator can cover an orchard with a layer of fog up to five miles long and 200 yards wide. The fog itself does not produce heat, but acts as a blanket to prevent the loss of ground heat.

Industrial Uses. In industrial situations, the most obvious beneficiaries of Army chemical research are facory workers who handle toxic chemicals as a part of the production process. A basic piece of Army equipment, the standard protective mask, is adaptable for general use.

In addition, some of the Army's special-purpose masks and breathing apparatus provide protection against carbon monoxide, ammonia fumes and specific chemical vapors, biological agents and radioactive dusts.

Another recent CRDL development is a special "gun" for testing glass to be used in safety goggles. Using helium for the propellant and hypodermic needle tubing for the gun barrel, the gun serves to collect data for the formulation of safety practices. Findings apply to industrial workers whose jobs involve metal chipping, riveting, welding, lathe operations or any duties where flying particles constitute a potential hazard.

CRDL scientists have contributed to the development of a device that detects liquid levels in containers, such as compressed gas cylinders, with steel walls up to three-quarters of an inch thick. The high cost of steel molds for small parts needed in experimental injection-molded plastics led CRDL materials-research engineers to produce molds of metal-filled epoxy resins—a technique having many industrial uses.

In-House Capability. Achievements such as here cited, and a long list of others little less deserving of mention, would not have been possible without maintenance of a strong in-house capability of highly trained, experienced scientists and technicians.

A good example is the work of Dr. Herbert Lipke, a biochemist in the Experimental Zoology Branch who has performed research at the University of Illinois on the housefly's ability to develop resistance to insecticides. As a result, he was granted a research fellowship by the United Nations World Health Organization to conduct a similar study on the malaria-carrying mosquito.

Acquired resistance of mosquitoes to modern insecticides has been threatening to reverse advances made

(Continued on next page)

"It's Little Things That Count" . . .

In Top Woman Scientist's Research at CRDL

A woman scientist honored with the Army's highest civilian award, the Decoration for Exceptional Civilian Service, is a firm believer in "It's the little things that count."

Gabrielle Asset is employed at the U.S. Army Chemical Research and Development Laboratories at Edgewood Arsenal, Md., where she is known as the designer and operator of two wind tunnels used in research on aerosols.

Studies of the diffusion and impaction of aerosols in turbulent air flows are directed primarily toward the medical research aspects of chemical aerosol behavior — seeking knowledge important to civil defense as well as protective measures for military personnel.

Miss Asset began her career with the Chemical R&D Laboratories in 1946 and placed her first wind tunnel in operation in 1952. A larger tunnel was completed in 1960. By introducing an aerosol mist into a wind tunnel and controlling the rate of air flow, she is able to observe how airborne chemical agents are affected by varying wind conditions.

In general, her work on aerosols concerns the mechanical, electrical and optical properties of the tiny aerosol particles, as well as the fluid dynamics of particles and air flow.

Specific studies which she has conducted include how aerosols in moving air streams are deposited on human arms, the process by which aerosols enter and penetrate the nasal passages, the toxicity of particulates created by combustion of jet fuels and oils, and how particles travel in turbulent air flows.

In addition, she has developed and patented a solenoid-operated microburette, a laboratory device that produces either a single droplet or a continuous series of droplets of substantially the same size.

In 1961 when she received the Secretary of the Army Decoration for Exceptional Civilian Service, she was cited for her contributions to the Army R&D program through "her planned research in the various fields of the dynamics of aerosols and particulate matter in air flow, together with her design and operation of two completely unique wind tunnels. . . ."

After receiving a B.A. degree in physics from Barnard College (1928), she earned master's degrees from Wellesley College (1931) and Radcliffe College(1933). She has done graduate work in electronics and physics at Cornell University and in fluid dynamics at Johns Hopkins University.

Senior author of numerous scientific papers in the field of aerosol research, she holds membership in the American Physical Society, the American Industrial Hygiene Association and the Scientific Research Society of America.

Miss Asset is listed in the 10th edition of *American Men of Science.*

Gabrielle Asset loads a dispenser with crystals which are then introduced into the wind tunnel for observations on airflow and the mechanical, electrical and optical properties of the aerosol particles under test.

against the malaria death rate by the UN's World Health Organization in recent years. CRDL granted Dr. Lipke a leave of absence in order to permit him to pursue research under the UN grant at England's renowned Ross Institute.

One of CRDL's most distinguished scientists, Dr. David B. Dill, served the Laboratories as deputy director of medical research from 1947 until his retirement from Government service in 1961. Dr. Dill was responsible for organization of much of the research that developed the mouth-to-mouth method of artificial respiration and the mechanical respirator.

In recognition of this and other administrative and scientific achievements, he received both the Decoration for Exceptional Civilian Service from the Department of the Army and the Distinguished Civilian Service Award from the Department of Defense.

Dr. John A. Clements, formerly assistant chief of the CRDL Clinical Investigations Branch, was instrumental in the discovery of and continued research on a previously unknown lung lining fluid that affects breathing. The original purpose of his work was to develop better medical treatment for chemical casualties. It proved, however, to be of particular value to scientists studying asphyxia of the newborn, which kills about 25,000 infants in this country each year.

Inter-Agency Cooperation. All CRDL scientists maintain close liaison with their counterparts in other Department of Defense organizations, as well as with a vast number of Government, university and private research agencies. This permits exchange of information, precludes unknowing duplication of effort, and aids in problem-solving.

Armed Services forward their specific chemical problems to the Laboratories, where a concerted effort is made to gather the necessary data for developing protective and therapeutic devices and techniques useful in war and in peace.

Dr. Seymour D. Silver, CRDL Technical Director since 1961 . . . Yale College, bachelor's degree, chemistry (1927); Yale University, Ph. D., organic chemistry (1932) . . . toxicology and chemist positions at Worcester (Mass.) State Hospital, Eastern Bonded Winery and Lee Chemical Co., Hartford, Conn. . . . progressively responsible positions at Edgewood Arsenal and Army Chemical Center, Md. . . . member of various chemical, industrial and scientific research associations . . . author of more than 87 technical reports on R&D progress.

Dr. Berger, Hormats Step Into CRDL Director Posts

Dr. Bernard Berger and Saul Hormats recently stepped up the Federal scientist career ladder at the U.S. Army Chemical Research and Development Laboratories (CRDL), Edgewood Arsenal, Md.

Dr. Berger, a scientist and management executive with CRDL since 1946, is the new acting director of Weapons Systems. Prior to his appointment, he was chief of the Munitions Development Division.

During his rise from organic chemist to a directorship, he attended a dozen special service schools. Among them were a Chemical-Biological-Radiological Orientation Course, Dugway, Utah; a Nuclear Weapons Orientation, Sandia, N. Mex.; a Modern Warfare Orientation, Fort Bliss, Tex.; and the Army Project Managers' Course, Fort Lee, Va.

Dr. Berger received his Ph. D. in organic chemistry from the University of North Carolina in 1939, and held a post-doctoral fellowship from the Naval Research Laboratory for a year. He is a member of the American Chemical Society and the Scientific Research Society of America.

During World War II, he received a commendation for Meritorious Civilian Service from the War Department for his work in connection with protective clothing. He also has served as United States representative at various Tripartite and NATO group defense meetings.

Dr. Bernard Berger

Saul Hormats

SAUL HORMATS, newly assigned as director of Special Projects, is responsible for the Laboratories' flame program, including portable, mechanized and air-delivered flame systems and related support equipment.

Upon graduating from Johns Hopkins University (1931), Hormats began his career as a chemist at the Arsenal. During more than three decades with the Laboratories, he has held progressively more responsible positions in management.

He advanced from chief engineer of the Protective Division to head of that Division, then deputy director and director of Development.

In addition to contributing articles to the scientific journals, he has been granted numerous patents on adsorbents, respirators and detectors. He is a member of the American Chemical Society and the American Association for the Advancement of Science.

Two Years of Effort Land Job

Australian Engineer Proving Worth at GIMRADA

U.S. Army research and development associates of an Australian engineer who joined them after two years of often discouraging effort are finding cause to be glad he succeeded.

Desmond O'Connor is proving, as an employee of the U.S. Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA) at Fort Belvoir, Va., that he is a valuable asset.

On Oct. 3, 1961, he addressed a letter of inquiry regarding employment opportunities at GIMRADA, located at the home of the U.S. Army Engineer Research and Development Laboratories. Much more paperwork later, his departure seemed imminent in August 1962.

Then it was discovered that the necessary travel authorization for Mr. Desmond and his family, wife Barbara and children Liame and Caitriona, could not be issued until 12 months later. On July 15, 1963, they embarked for Washington, D.C., though 80 copies of travel orders authorizing departure were not delivered until one month after their arrival in the U.S. capital.

Since then they have made many friends, intend to become U.S. citizens in due course, and are happily settled in every way.

In his GIMRADA assignment, Desmond is demonstrating ability as a researcher concerned with the application of modulation transfer theory and systems analysis to the photogrammetric measurements.

GIMRADA is the principal field agency of the U.S. Army Corps of Engineers for the research and development of new materiel, methods and techniques in the fields of geodesy, surveying, mapping and engineer intelligence.

O'Connor holds a bachelor degree from the University of Sydney, Master of Engineering from the University of South Wales, and Master of Science from the International Training Centre for Aerial Survey, The Netherlands. He is a Fellow of the Royal Geographical Society of London, and was senior lecturer in civil engineering at the University of New South Wales when he resigned to come to this country.

Desmond O'Connor, who emigrated from Australia to become a U.S. Army scientist, explains boomerang to Col Van Atta, GIMRADA chief.

GIMRADA Studies Lasers for Mapping, Geodesy

Application of lasers to problem areas in mapping and geodesy is being investigated by the U.S. Army Corps of Engineers Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA).

One potential application in geodesy is for ultra-precise distance and angle measurements between points on the earth's surface, between ground and aircraft and aircraft and ground, and between earth and satellite and satellite and earth. Another is for monitoring baseline shift, shifts of the earth's surface, and earthquakes. Lasers may also be used as gyroscope and rotation sensors, and as part of a gravity measuring system.

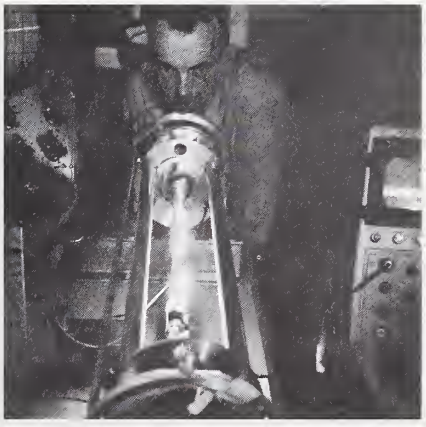
In mapping and photogrammetry, lasers may be applied to height measuring, and to extremely fine resolution of lines and points on photographic plates, as well as to measurement of distances between these lines and points.

The GIMRADA in-house research program at Fort Belvoir, Va., is expected to provide direction for future applications of lasers in geodesy and mapping. One objective is to determine how closely the physical limit for measurements can be approached.

Investigations will cover laser beam characteristics; modulation, detection, demodulation and signal processing techniques and equipment; electrical and photo-electrical phase measurement; noise problems; laser amplifiers, receivers and transponders; and photomixing and optical heterodyning.

Certain phenomena such as Doppler, Zeeman and Faraday Effect also will be studied for application to geodetic and mapping systems. Another important investigation will be atmospheric refractive index studies and the study of propagation effects.

GIMRADA now has a continuous-wave gas laser and auxiliary equipment to be used in these investigations. Special features include continuous output, and mirrors which can be adjusted by micrometers or magnetostriction.



Continuous wave Laser is used by GIMRADA in research on Laser applications to geodesy and mapping.

Federal Service Vet Named Deputy Personnel Director

Donald S. Rubenstein, at 47 a 23-year veteran of the Army's Career Program, became the deputy director of Civilian Personnel early in December when John Will left for a new job as Director of Personnel, U.S. Department of Commerce.

Groomed for his new assignment by service as assistant director of Civilian Personnel for Program Planning and Evaluation since March 1962, Mr. Rubenstein entered the Federal Service in 1940. After serving in civilian personnel management at Camp Blanding, Fla., he moved to Aberdeen Proving Ground, Md., until he left for three years of Army military duty (1943-46).

Progressively responsible Career Program assignments in Washington, New York City and Illinois followed his discharge from the Army. Since 1954 he has been with Civilian Personnel in Headquarters, Department of the Army.

In 1955 he served with the Kushnick Committee to implement Hoover Commission recommendations in the Department of Defense. Serving with the Holescher Committee in 1961, he had an opportunity to study problems which in 1962 led to major reorganization of commands in the Department of the Army.

Weapons Command Centers Basic Research on Goal Of Stronger, Lightweight Materials for Weaponry

The U.S. Army Weapons Command research and development program, like the world today, is in a state of dynamic change.

Headquartered at Rock Island (Ill.) Arsenal, the Command spent nearly $30 million during fiscal year 1963. Slightly more than $1 million was for basic research, $2 million for supporting research, and the bulk for development of weapon systems.

In the basic research programs, emphasis has been on increasing strength of materials, reducing weight, upgrading thermal characteristics, and improving production.

One of the more recent noteworthy advances is a new rubber material, developed by the Rock Island Arsenal laboratories, in which silicon and carbon atoms have been bonded. Such materials, known as silcarbanes, can be vulcanized using conventional procedures. Heat stability is intermediate between natural rubber and silicones.

The process offers the possibility of modifying present rubbers to produce better heat stability and more flexibility at low temperatures, as well as improving other properties.

For example, it has also been found that incorporation of five percent acrylic acid into a rubber compound reduces the amount of high-energy radiation required for good cure. Roughly one-tenth the radiation otherwise required is necessary, and this energy can come from byproducts of radiation materials.

The development of the new lightweight towed 150 mm. howitzer, the XM102, gives a significant improvement in range, lethality, mobility and reduction in weight. Transportable by helicopter, it is deliverable by parachute, and can negotiate inland waterways with the aid of a flotation kit. Gun crew manpower requirements have been reduced and significant reduction in time for emplacement and weapon response has been achieved. The XM102 uses a muzzle brake to reduce recoil forces, and can rotate 360° in firing.

The 107 mm. Mortar/Ammunition system is being designed for increased operational mobility, greater and more effective firepower, and increased range with improved ammunition. The lightweight mortar will have the capability of using existing stockpiles of 4.2-inch mortar ammunition. It will be man-portable and may have an auxiliary wheeled device.

RAPID-FIRE WEAPON SYSTEM. Current and predicted tactical and technical trends indicate a need for a new machinegun or automatic weapon which provides greater effectiveness at longer ranges than can be achieved by the standard caliber .50 machinegun.

Increasing use of lightly armored personnel carriers stresses that armor penetration be a dominant characteristic of the new weapon, intended for use both on and off vehicles against materiel, personnel and certain classes of aircraft.

The Army Weapons Command has investigated the potential of several 20 mm. weapon systems to fulfill the need at least on a relatively short-term basis. The most promising weapon, the Hispano-Suiza HS 820/L85, is being tested at Aberdeen Proving Ground, Md. This weapon and its ammunition have been adopted by the Federal Republic of Germany. Should the system be adopted for use by the U.S. Army, another NATO objective will be met.

MODERN GUERRILLA WARFARE has established requirements for new and novel weapons along with improvement and modification of existing weapons. USAWECOM is engaged in developing a shoulder-fired weapon for use by the U.S. Army Special Forces in guerrilla and counterguerrilla operations in remote areas of the world. Development activities are underway on the modification and improvement of shotguns and shotgun ammunition for use by both the military and indigenous personnel of foreign countries.

SPECIAL PURPOSE WEAPONS. Considerable publicity has been devoted recently to the Special Purpose Individual Weapon System and its place in the Army's overall weapons development program. The primary objective of this endeavor is to place in the hands of the individual soldier a lightweight system with which he can more effectively engage a greater variety of targets.

Several contractors are delivering proposed weapons which will be comprehensively tested. Evaluation of results will determine the future course of development. The intent is to resolve the development program into a single technical approach for a final development phase.

U.S. Government agencies participating in this development under USAWECOM management include, in addition to Springfield Armory, the Frankford Arsenal, the Ballistic Research Laboratories, the Human Engineering Laboratories, Picatinny

Urethane Rubber Fuel Tanks Added to Personnel Carrier

A fuel tank made of urethane rubber and nylon is being produced for the Army's M-113 versatile, lightweight armored personnel carrier.

A new rubber spraying technique developed by Goodyear to produce fuel tanks for light aircraft was applied to requirements for the M-113, an air-transportable carrier that can operate over the roughest terrain in a wide variety of climates.

Maj Gen Nelson M. Lynde, Jr.

Maj Gen Nelson M. Lynde, Jr., who has headed the U.S. Army Weapons Command since it was established effective Aug. 1, 1962, is a U.S. Military Academy graduate (Class of 1929) and a veteran of Ordnance and Armor units.

Throughout World War II he served in Europe with the Seventh, First and Fifteenth U.S. Armies, winning the Legion of Merit and Bronze Star Medal, both with Oak Leaf Cluster.

Transferred to the Ordnance Corps after the war, he was returned to Fort Knox, Ky., where he was first assigned after graduating from the Academy. He remained at the Armored Center until reassigned as Ordnance officer of Army Field Forces.

In 1953, he was ordered to the Far East with responsibilities for operation of Ordnance base depots in Japan, for which he was awarded a second OLC to the Legion of Merit. Upon return to the U.S. in 1955, he headed the Ordnance Tank-Automotive Command in Detroit.

Appointed Assistant Chief of Ordnance in charge of the Field Service Division in 1959, he continued in that capacity until he became commanding general of Ordnance Weapons Command at Rock Island Arsenal in May 1962.

Arsenal and the Army Materiel Research Agency.

Elements of the Combat Developments Command and the Test and Evaluation Command are represented on the USAWECOM teams which plan, direct and appraise the technical aspects of this development. It is considered a tribute to the participating agencies that, as of this date, every event in the pre-planned program has been met on or before the scheduled date.

As the U.S. Army Weapons Command faces the future, its research and development program will continue its mission to develop superior firepower for combat forces.

Col Raymond W. Burkett

Col Raymond W. Burkett came to his present assignment as director of the R&D Directorate of the U.S. Army Weapons Command in March 1963 after serving in that same capacity at the U.S. Army Missile Command from 1959. Graduated from Georgia Tech with a B.S. degree in electrical engineering, he has used his technical background to good advantage in a series of key assignments in the U.S. and Korea during his military career.

After completing a course at the Army War College in 1954, he was assigned to the Armed Forces Special Weapons Project at Albuquerque, N. Mex., and in August of 1956 began a 2-year tour of duty with the Army Inspector General staff. A tour in Korea preceded assignment to the U.S. Army Missile Command.

M4A1 Simulator Offers $2 Million Annual Savings

A weapon firing simulator believed capable of saving the Government about $2 million annually in troop training costs has been developed in its present form at the Army Tank-Automotive Center, Detroit, Mich.

Designed to create the sound, flash and smoke of tank and artillery weapons (76 mm., 90 mm. and 105 mm.), the M4A1 simulator provides an environment of battlefield realism for combat troops in field exercises.

Basically an electronic device, the simulator consists of a stainless steel combustion chamber, a gas generator and an electrical control box. Oxygen and propane gas create the flash and sound. Titanium tetrachloride propelled by Freon gas causes smoke.

The simulator is mounted on the weapon of a tank and has a ground mount adapter when used as an artillery piece. It is designed for use with the M41, M48 and M60 tanks.

The U.S. Army Armor Board, Fort Knox, Ky., initiated the requirement for a simulator about 10 years ago. After six years of development research conducted at the Naval Training Devices Center, Port Washington, N.Y., the project was assigned to ATAC for final modification. Max Alexander was assigned from ATAC's Firepower Lab to serve as project engineer.

Under the 1962 Army reorganization program, the simulator was designated as an item belonging to the U.S. Army Weapons Command (WECOM), Rock Island, Ill. Since all the work had been handled at ATAC, it was determined that ATAC, under WECOM supervision, would continue the project.

Subsequent redesign has made the M4A1 more efficient, lighter weight, more realistic and less costly to produce than the original model—about $1,100 a unit, a saving of more than 50 percent, Alexander stated recently.

"We can fire the simulator," he said, "for about 25 cents a round. Blank ammunition costs from $8 to $11 a round, depending on the size."

During the past five years, expended blank rounds of 90 mm. and 76 mm. ammunition have cost the military services close to $2 million a year.

Prolonging the operating life of weapons is another reason for the use of simulators. Weapons that have fired blank ammunition must be cleaned at the end of the day to avoid corrosion. No cleaning of weapons is necessary with the simulator.

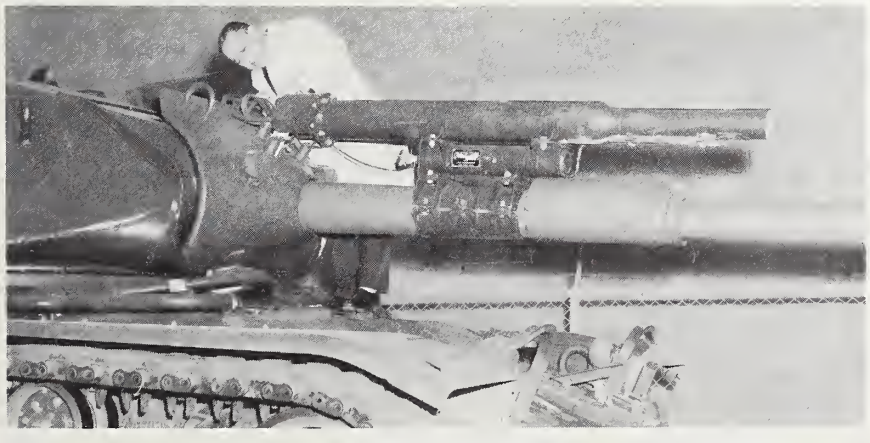
As a training device, the simulator serves a twofold purpose. It introduces ground troops to the sounds and gun flash of battle and it also provides tank crews with an opportunity to test their skills.

In conjunction with an electronic device known as a hit-kill indicator, the simulator can be used for training exercises where opposing tank forces engage in mock battles. The indicator employs radio beams and infrared signals to measure the accuracy of simulated gunfire.

When one tank scores a hit on another, a fuse in the disabled tank's simulator is blown, making the device inoperative. The crew scoring the hit is notified by its own indicator that the enemy vehicle has been knocked out of action.

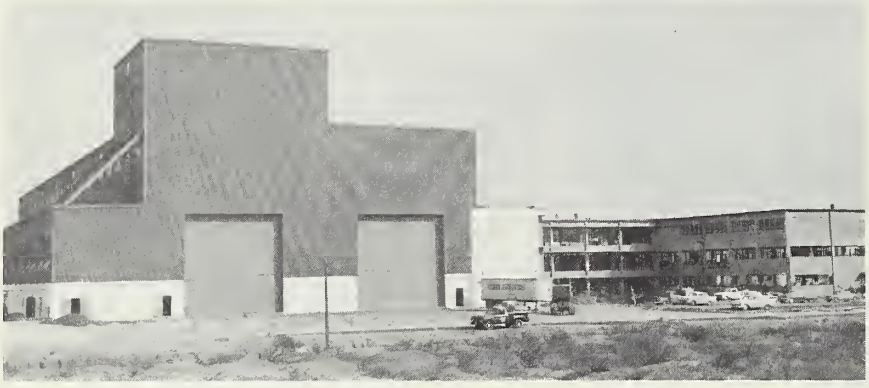
Of the more than 450 simulators now in production under contract with the Food Machinery Corp., San Jose, Calif., 100 will undergo intensive testing at the Combat Development Command Experimentation Center, Fort Ord, Calif.; 315 have been assigned to the Continental Army Command (CONARC) and U.S. Army Forces in Europe (USAREUR); and 30 for U.S. Army Forces in the Pacific (USARPAC).

Interest in the simulator has developed among quadripartite allies. The Canadian and British Armies will receive three simulators for experimentation studies before the end of the year and the Australian Government has indicated a strong interest.



Max Alexander, project engineer in Army Tank-Automotive Center Firepower Laboratory, inspects M-4A1 weapon simulator mounted on M60A1 tank.

Missile Command Scientists Show Deadly 'Birds' Require Techniques of Value to Civil Community



New $4.3 million R&D building under construction at Redstone Arsenal.

Ballistic missiles that can carry death and destruction thousands of miles in minutes are not normally considered as yielding byproduct benefits of Army R&D for the civilian population, even in the most imaginative mind.

Missiles, a formidable array of them, are the business of the U.S. Army Missile Command at Redstone Arsenal, Ala. Quite logically, it might be concluded that notable scientific achievements responsible for the success of that business do not contribute materially to a better way of life, except to help preserve peace and win wars.

That would be an unsound presumption. The advanced technology needed for modern ballistic missiles has produced know-how that has had a profound impact on techniques used by industry to produce new materials, instrumentation, protective and preservative coatings and many other items important for civilian use.

Quite aside from the consideration of the scientific byproducts aspects of missiles R&D, however, are the economic aspects. The Army missile business is big business, involving expenditure of about $1.5 billion annually. Roughly 90 percent of that total goes to American industry, providing employment to many thousands of people.

Redstone Arsenal bustles with mass activity and the Missile Command employs additional thousands (a combined total of about 12,000) throughout the U.S. and in foreign lands where joint effort is underway.

Developmental work at the Arsenal has included such missile systems as the Pershing, Sergeant, Mauler, Hawk, Lance, Nike Hercules and the Army's answer to the threat of missile attack, the Nike Zeus and Nike X antimissile missile system.

Facilities required for this massive missile effort are continually growing. Expected to be completed early this year is a new $4.3 million laboratory and shop unit containing $1.5 million worth of new equipment. Construction was commenced in 1960.

Eight laboratories now scattered over a 10-mile stretch will be housed in the new facility. The consolidation will include labs for Advanced Systems, Structures and Mechanics, Ground Support Equipment, and Electromagnetics. Some 500 R&D Directorate personnel will be accommodated in the 3-story building which has 205,800 square feet of floor space.

Among the high-precision instruments that will increase R&D capabilities in the new laboratory building are a Marquardt Universal Testing Machine and a 2,000,000-power microscope.

The Marquardt machine can be programed to carry out, automatically, testing procedures such as complex stress cycles. The former method of resistance heating of materials under test could be applied only to conductive materials.

The electron beam furnace of the Marquardt tester can be used to heat nonconductive materials such as ablative insulation. It can boost temperature of the specimen by as much as 1,500° F. per second, with an upper limit beyond the melting or destructive point of most materials.

A capability for heating specimens during testing to the high temperatures possible with the Marquardt machine is important for missile research, to simulate the conditions inflicted on missile components by the blast of rocket motors and atmospheric friction.

The 2,000,000-power field ion emission microscope will be used primarily to study the crystalline structure of materials. It is powerful enough to resolve the atoms in an iron specimen. Since the R&D Directorate does a great deal of basic research in materials used in missile systems, the new capability is important.

Thermo-property equipment capable of subjecting test materials to temperatures up to 6,500° F. will be installed in the new laboratory.

The 420-foot-long shop area contains laboratory space and high bays. The 50- and 80-foot heights in the bays will accommodate an entire mis-

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Maj Gen John G. Zierdt

Maj Gen John G. Zeirdt, who assumed leadership of the U.S. Army Missile Command in September 1963, achieved national prominence as project officer and a most enthusiastic spokesman for the Army's Nike Zeus missile system.

General Zeirdt was graduated from the United States Military Academy in 1937 and since then has spent a good share of his military career at Redstone Arsenal, Ala., or as a field emissary of Missile Command Headquarters.

Possibly no military leader in the history of Army missilry can claim a longer continuing high-level association with important research and development progress than General Zeirdt. This was recognized when Lt Gen Frank S. Besson, Jr., CG of the U.S. Army Materiel Command, nominated him for his present job.

General Zeirdt played a key role in development of the Army's Jupiter intermediate-range ballistic missile before he moved up to a succession of progressively important assign[illegible] including: Army Ordnance Missile Command (AOMC) chief of staff, [illegible]my Rocket and Guided Missile Agency deputy commander and later commander, and commanding general for Guided Missiles of the AOMC.

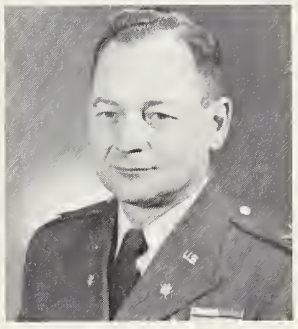
While in military service he did graduate work at the Massachusetts Institute of Technology. He is a graduate of the Command and General Staff College, Fort Leavenworth, Kans., and the Army War College, Carlisle, Pa.

sile in the vertical position for structural testing of components.

The shop will be fully instrumented to record stress, temperature, pressure, vibration, shock and electrical measurements. Missile tiedown bolts are designed for 250,000 pounds of tension stress. Five 20-ton bridge cranes will serve the high bays.

Several electrical systems will be used in the new laboratory, including 400-cycle and 28-volt general for precision work. Other electrical systems will serve two recording centers (oscillographic and analog to digital) as well as two air distribution systems, air purification station, and various equipment.

The broad scope of missile research is reflected in the equipment being installed in the new laboratory. In the continuing search for new knowledge to broaden scientific horizons, the Army Missile Command is producing results that increase the Nation's military capabilities, as a first priority, but more often than one might suspect find application to new or improved products for civil needs.



Col Daniel F. Shepherd

The U.S. Army Missile Command's Directorate of Research and Development is headed by Col Daniel F. Shepherd who has been in guided missile development since the end of World War II and has held his present job since April 1963.

Typical of Missile Command officers with an engineering background, he received his B.S. degree in mechanical engineering at the Massachusetts Institute of Technology in 1934.

Col Shepherd entered active duty in 1941 and was principally concerned with ammunition and supply during the war years. At the end of the war he went to Sandia Base, N. Mex., and later to Washington, D.C., where he was engaged in atomic weapons and missile development.

In 1956 he moved to Redstone to assist in the organization of the fledgling Army Ballistic Missile Agency and served a 3-year tour. In October 1962 he returned to Redstone from Picatinny Arsenal, Dover, N.J., where he was successively director of Ammunition Group, director of Special Weapons Group, and deputy CO.

NATO Hawk Office in Paris Serves Missile Command On Difficult Job of 5-Nation Uniformity of Weapons

Rueil-Malmaison, a suburb of Paris, is the home of the NATO Hawk Liaison Office, one of the most important U.S. Army Missile Command offices overseas, controlled from Redstone Arsenal, Ala.

The Sergeant and Pershing Projects have overseas offices, and the Nike Zeus Project maintains a staff in such faraway places as Ascension Island in the Atlantic and Kwajalein Island in the mid-Pacific.

But the NATO Hawk Liaison Office is different. For one thing, it deals with an organization of five NATO governments that are manufacturing Hawk systems on their own soil. They are France, Italy, Germany, Belgium and The Netherlands. Not many major American defense systems are manufactured overseas. Two are the F-104 Fighter and Sidewinder air-to-air missile. Neither of these belongs to the Army.

Dealing with the problems of Allied countries building, maintaining and operating their own Hawk Air Defense Missile Systems for their own protection is where the liaison offices comes in.

NATO Hawk was made possible by the Ottawa agreement which established NATO, under whose authority the production organization was created. The United States furnishes technical aid and provides dollar credits against which the five countries purchase U.S. materials.

One of the requirements was that a Hawk system built overseas must be like the one built by Raytheon, the U.S. Hawk prime contractor, and its subcontractors. Col Paul B. Schuppener, the NATO Hawk Liaison Officer says results are commendable.

To achieve this, the Liaison Office helps explain to engineers and technicians what their American counterparts are talking about. A scientific term on an engineering document might have no comparable meaning in Flemish, for example. Or an Italian engineer used to the metric system finds himself confronted with American blueprints with all the measurements in inches and fractions.

Not only that, but European production people have different ideas about fabrication of their products.

The manuals for the Hawk system form a stack something like six feet tall—every word of it in English. English language manuals published in Europe will also be used on the foreign-built Hawks, manned by Allied NATO troops.

The problem of translation is eased somewhat by the fact that the European troops are taught operation and maintenance of the system in the United States, notably at the Ordnance Guided Missile School at Redstone Arsenal and at Fort Bliss, Tex.

Col Schuppener is thoroughly familiar with the Army's missile program. He was Assistant Guided Missile Coordinator in the Office, Chief of Ordnance from 1955 until 1959. Prior to going to Paris over a year ago he was Deputy Chief of Research and Development at the Army Ordnance Missile Command.

His direct contact on this side of the Atlantic is the Hawk Project Office, headed by Col Charles Graham. In Paris he deals with the NATO Hawk Production Organization, the watchdog over European contractors, and SETEL (Societe Europeenne de Teleguidage), European prime contractor.

Organized under French law, SETEL receives policy guidance from a board of directors representing the five national prime contractors. Altogether there are more than 170 prime and subcontractors involved.

Almost daily contacts with EUCOM (European Command), SHAPE (Supreme Headquarters Allied Powers Europe), and DEFREPNAMA complete the picture of liaison activities. DEFREPNAMA stands for Defense Representative, North Atlantic-Mediterranean Area, and is part of the U.S. Secretary of Defense office, with abode in Paris.

The NATO Hawk office has two official languages—French and English.

If you're ever in Paris and feel like discussing Redstone Arsenal, drop in. A large part of Col Schuppener's staff came from Redstone, including Majs John Levaas, Hans Strohm and James Butterworth, CWO John Caulkins and Mrs. Genevieve Redpath.

Army Materials Research Agency Points to Results Of R&D That Have Served to Improve Civil Products

This article was coauthored by Dr. L. S. Foster, physicist and chief of the Technical Information Center; John J. Burke, materials engineer; Robert Colton, metallurgist; and Paul Vogel, mechanical engineer. All are employees of the U.S. Army Materials Research Agency, Watertown Arsenal.

The more removed from end-item application the program of a military agency may be, the less obvious is the direct relationship to a new civilian product. Along the way, the origin of the idea is obscured by the intertwining of ideas and concepts by a great many people.

Especially is this true when the idea is developed by civilian contractors on military funds—so that the idea may ultimately look like a proprietory development of the contractor. It is important, therefore, for the military organizations to publicize their contributions to materials and products that become important in civilian applications.

The commerical aircraft of today is the civilian version of former military aircraft, developed and flight-proven by the Armed Forces. Similarly, the Army materials research program is first proven in military applications. Then it is used by American industry in conducting its Government-supported research and development contract work. Finally the know-how is translated to materials and material processes for the civilian economy.

Television Radiography. A typical development is that of Television Radiography which is now being adopted by an increasing number of commercial manufacturers as a continuous method to inspect materials. The original concept was the subject of various patents reaching back through the years.

The present sensitivity and speed of inspection, however, is the direct result of research conducted by the U.S. Army Materials Research Agency (AMRA). The latest contractor was Ohio State University.

Radiography, as now developed, eliminates the costly and time-consuming use of X-ray film. Instead, the internal flaws that may exist in a component are detected by X-rays, but the image is projected on a television screen through the use of an X-ray sensitive vidicon tube. This permits continuous inspection, as well as magnification of any details that may require closer scrutiny.

One-Sided Infrared Inspection. Another nondestructive inspection technique utilizes heat flow away from a surface to indicate the quality of the bond. The better the bond is at the interface, the more rapid is the rate of cooling. Detection of the variations in infrared emission over the outer surface will reveal voids and areas of delamination.

Particular interest has been shown by the manufacturers of helicopter and fixed-wing aircraft who are constantly investigating improved methods for testing structural components for maximum flight safety.

Improvement in Foundry Practice. AMRA has investigated new techniques in casting and cermet technology which have been adopted by industry, particularly the recent fluidbed technique for building molds, and the unidirectional solidification process to achieve cast structures of superior microstructure, strength and ductility.

Prediction of Brittle Failure. The civilian community, which uses a wide variety of pressure vessels, will benefit from the development of a dynamic test setup developed at AMRA. Used in missiles that are subjected in service to high rates of loading, both at extremely low and extremely high temperatures, this system permits peak loading from nearly static to a few milliseconds with simultaneous temperature control from —200° F. to +500° F.

New Materials—Titanium. Even though industry undertakes numerous studies of new materials, sometimes, because of the magnitude of the development of a new metal from the initial demonstration of its desirable properties to its ultimate production on a large-scale, support of the R&D effort by Government is required. Equally important is the need of a market for the product.

Titanium development from a laboratory curiosity to a commercial product was primarily the result of support of the Armed Services' need for strong, lightweight metals. The original demonstration of desirable properties was the work of the Bureau of Mines which, in 1946, showed that high-quality titanium was strong and ductile and possessed a very high strength-to-weight ratio.

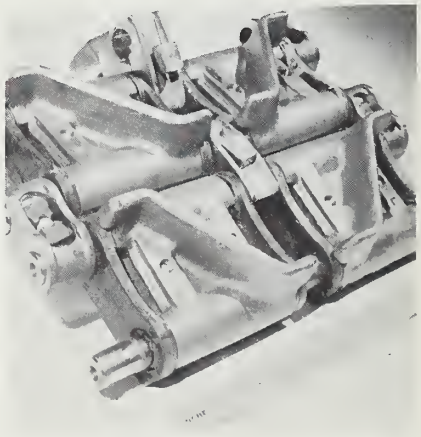
From a small beginning in 1946 until the present, the Army has invested only $20 million in the development of this metal and its alloys. That sum is more than matched by the investment of industry in mines, production plants, research and development effort, sales promotion, etc.

Without the initial input of military funds at the crucial stage, however, it is likely that the commercial exploitation of this important new structural material would have been extremely slow.

The Army's first contract with titanium occurred in 1946 when Dr. Peter P. Alexander of Metal Hydrides, Inc., Beverly, Mass., supplied a fairly large sample of titanium metal to the Office, Chief of Ordnance for evaluation as possible armor plate material. From hindsight, it is now seen that the properties of this rather crude product would have been very discouraging had it not been for the timely publication of information on *Ductile Titanium* by the Bureau of Mines.

Imagination of Army scientists at Watertown Arsenal was stimulated by these events. With the encouragement of officers like Col Benjamin S. Mesick and Army civilians like the late Dr. Horace H. Lester and Dr. James L. Martin, a rapid expansion in the investigation of the properties and potential applications of titanium and its alloys was initiated.

Coupled with a military-supported industrial crash program, this effort has brought titanium to the advanced state in which it exists today. *The Ordance Corps Titanium Program—1946-1961,* published as a monograph in February 1962, explores in great detail the early titanium effort of the Army. Edited by John J. Burke, it is available from Office of Technical Services, U.S. Department of Com-



T-109 titanium tank track assembly.

merce, Washington 25, D.C., under number AD 276,639.

Titanium is used extensively by the Army in various weapons and support systems and is being explored for others. An example of one potential use is a titanium tank track assembly.

Numerous nonmilitary applications, however, are the result of time, money and effort spent by military agencies in the development of titanium as a commercially important and new structural material.

Before enumerating industrial applications of the metal itself, it should be pointed out that among the benefits of the extensive program to develop titanium are many important contributions to technology that had to be evolved to handle this metal.

Among these are new methods of testing and nondestructive inspection, processing in inert atmosphere or vacuum, fabrication routines to achieve desired microstructures, and coatings to avoid the characteristic galling of mating parts.

The advancement of scientific methods and techniques is making it possible to exploit a neglected chemical element that is very abundant and that has an unusual combination of desirable characteristics.

A great many titanium research returns for civilian applications and industries have been forthcoming for some 15 years. Because of the superior resistence to corrosion, in the chemical industry alone applications are seen in piping, reaction chambers, catalytic agents, construction of autoclaves, heat exchangers, chemical processing racks, valves, and so on, to cite only a few of the titanium items currently in mass production.

In the electronics industry, titanium is used as a substrate and an oxygen "getter." In the aircraft industry, titanium has many advantages for structural members and for skin sections of subsonic and supersonic aircraft. Titanium barrels of guns and armored vests are forthcoming. Medical applications include surgical instruments and artificial joints and attachments. In aerospace, many uses are found in satellites and nonorbital vehicles.

Titanium is as corrosion-resistant as platinum in sea water. Applications include propellers, hardware exposed to the ocean, and fishing reels.

The automotive industry plans now to evaluate titanium for use in transmission and engine components, and many new military applications are being explored. The result is that the commercial production of metallic titanium has steadily increased until in 1963 it reached a figure of 12 million pounds per year.

The price has been reduced to the point where titanium is a serious competitor of stainless steel. The scrap cannot be reclaimed at present and this limits further price cuts.

The continuing military, as well as commercial, interest in high strength-to-weight ratios of structural materials has produced a number of new titanium alloys. The Army Materials Research Agency is interested in one that contains, in addition to titanium, six percent aluminum, six percent vanadium, and two percent tin, as well as several minor components.

On a strength-to-weight basis, this alloy is equivalent to a steel having a yield strength of 325,000 pounds per square inch. Because it has the same tendency to gall as all titanium materials, an extensive program of development of solid-film lubricants is underway. Results have indicated wide applications, not only to titanium and its alloys, but in all fields of wear prevention.

In summary, AMRA's basic research in materials sciences, materials engineering and in materials testing is oriented primarily to solve military problems. As the results of the research are applied in production by civilian contractors, this know-how is translated into civilian applications in the form of direct uses or more usually as "hidden values" of improved materials and methods.

HEL Conducts Human Engineering Orientation Course

U.S. Army activities in the field of human engineering, that is, designing materiel with scientific regard for the physical limitations of users, might not seem important to the average housewife—and they might not affect her if industry had not, as a result, become more aware of this problem.

In fact about one-third of the participants in recent years at the Army's annual conference on human factors and the related problem of engineering design have been representatives of industry.

The U.S. Army Human Engineering Laboratories (HEL) at Aberdeen Proving Ground, Md., are now stepping up the pace of effort to stimulate broader interest in this area of research. "Orientation to Human Engineering," a new course conducted from Nov. 18-22 at APG, is expected to be repeated every two months.

The objective of the course is to stimulate understanding of physical limitation factors in design of equipment so that it can be used most efficiently, with the least training, with the minimum of time expenditure, and with the least chance of error.

Admittedly, human engineering in equipment used at home, where presumably it operates under optimum conditions and is controlled by persons to whom split-second timing is not necessarily vitally important, is not of as great concern as it is in production of military materiel.

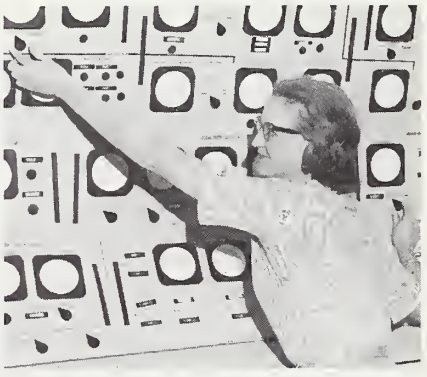
The Aberdeen orientation course concentrates on three main factors important to equipment designers—displays, controls and the environmental conditions under which equipment is used.

The concept is that equipment must tell the operator what it is doing and that the operator must be able to "tell" the machine what he wants it to do, with a minimum of effort and time. Emphasis is on the psychological principle, "we learn by doing."

For example, the course instructor, Dr. William Wokoun, explains that "I could tell you about how men work under blackout—but to really understand, you would have to work under those same conditions."

In addition to lectures by HEL scientists, the initial course included presentations from the Harvard University School of Public Health and the University of Delaware.

Participants in the course included military and civilian Army engineers, designers and project managers, ranging from Frankford Arsenal in Philadelphia, Pa., to Fort Huachuca, Ariz. Dr. Wokoun reports that he already has "quite a backlog" waiting for the next course.



As participant in human engineering orientation course at Aberdeen Proving Ground, Md., Donna Warren demonstrates that arms cannot be stretched to operate two switches needed simultaneously — illustrating equipment design not planned with consideration of human limitations.

Gigantic Computer Industry Sired by Army's World War Needs

By Daniel Marder
*& W. D. Dickinson**

Today's multi-billion dollar computer industry, a mainstay in the Nation's economy and shaper of its "industrial personality," was spawned as a result of the U.S. Army's urgent need for enormous amounts of firing tables and other ballistic data during World War II.

Firing tables for each new weapon required the calculation of thousands of trajectories to cover the various ammunition types and aiming conditions, and to account for effects of weather, earth's rotation, etc.

An individual with a mechanical desk calculator took 20 hours to calculate a single trajectory. This tedious task had been cut to 15 minutes by the Bush Differential Analyzer but, even at that rate, there was danger that the latest weapons could not go into service because firing tables were not completed.

Charged with the production of firing tables and other ballistic data, the U.S. Army Ballistic Research Laboratories (BRL), Aberdeen Proving Ground, Md., were desperate to find some new means of speeding computation. It was clear to the officer in charge of computations, Lt Col Paul N. Gillon, and his associates that the idea they sought would necessarily revolutionize methods of calculation. But they could foresee the birth to a new industry that would spur the economic growth of the Nation during the postwar decades.

BRL, in addition to its own Bush Differential Analyzer, had been using another Bush machine at the University of Pennsylvania. It was here that the idea was originated by Dr. J. Mauchly for an entirely new type of computational machinery—a machine that would calculate by the lightning impulses of electron tubes.

Encouraged by Lt Col Gillon, Dr. Mauchly, with assistance of J. P. Eckert, Jr., prepared the original outline of the technical concepts underlying electronic computer design.

A contract was quickly arranged, calling for the University of Pennsylvania to design, develop and construct an electronic computing machine. BRL mathematicians provided technical supervision and a good deal of development guidance.

By 1945 the ENIAC emerged. A 30-ton collection of circuits and tubes, it was capable of computing a trajectory in less time than the projectile takes to reach the target.

ENIAC and the continuing work of the BRL mathematicians drew the interest of Dr. John von Neumann of the Institute for Advanced Study (IAS) in Princeton. A contract was now arranged between Army Ordnance and the Institute for Advanced Study for exploratory work.

Together with Dr. Arthur W. Burks and Dr. Herman H. Goldstine (formerly in charge of BRL's computation group at University of Pennsylvania), von Neumann produced a paper setting forth the basic considerations for computer design. Its modest title—Preliminary Discussion of the Logical Design of an Electronic Computer—belied its impact.

Today, people still say, "There's been nothing really new in machine logic since von Neumann." The "Logical Design" became the blueprint for EDVAC which was built by the University of Pennsylvania for the Ballistic Research Laboratories.

Von Neumann's paper, which had never been published in any other form than a contract report to the U.S. Army, also served as the blueprint for a whole family of commercial computers, beginning with Sperry Rand's UNIVAC. From that time, the BRL became a clearing house and disseminator of computer information, a role still maintained.

Meanwhile, BRL was supporting the construction of a third computer by the University of Illinois, called ORDVAC, evolved on the basic design principles developed by the IAS, which also spawned a family of machines having names of such unusual interest as ORACLE, ILLIAC, SILLIAC, MANIAC; one, designated JOHNNIAC, honored von Neumann.

The computing industry had taken root in the early 1950s. Its nutrition was the information fed by BRL which sponsored studies that developed most of what was known about computer design.

The dissemination of design knowledge by the BRL was so wide that the U.S. Patent Office, in one instance, had to proclaim the information in the public domain. Yet the industry, although rapidly growing, was so small that most of the scientific computational workload of the western world was accomplished on the three machines at BRL.

Ten years ago the annual dollar volume of the computing industry was $10 million. Today it is very close to $2 billion, an astonishing 150-fold increase within a decade. About 20,000 computers are in use today. Four years ago, when some 3,700 were in service, a report of the Operations Research Office of Johns Hopkins University titled "Defense Spending and the U.S. Economy" reminded the industrial U.S. of its debt to the men who gambled on ENIAC:

"The present electronic computer industry is the direct product of Army-sponsored research resulting from a military need during the early years of World War II. . . . ENIAC had been produced and installed at BRL . . . at total cost of about $400,000. . . . The payoff possibilities to this country, indeed to the entire world, of the original $400,000 investment in R&D by Army Ordnance are staggering. . . ."

Almost in the role of responsible parents, BRL personnel have kept an eye on the proliferation of ENIAC's progeny. Today more than 350 kinds of computers, with a great variety of characteristics, have been manufactured and the variety is increasing steadily. Organizations in Government and industry seeking to eliminate gigantic calculation problems

ARMY R&D RESERVE UNIT effort to keep abreast of current R&D results, is illustrated by the view Col Max O. Schultze (left) and Lt Cmdr Jack Barber are taking of new devices at the UNIVAC Division of Sperry Rand Corp. in St. Paul, Minn. The Twin City Army and Navy Reserve R&D Units they command were given a briefing on new computer techniques and equipment including the $35,000 Hitachi electron microscope (shown here) which has a magnifying power estimated at 200,000.

* Daniel Marder is consultant and William D. Dickson is assistant to the director of the Ballistic Research Laboratories at Aberdeen P. G.

through the use of computers face the perplexing task of deciding which computer to choose.

Computers have been designed to control industrial processes and products, as well as to assist in executive decisions and the management of universities, banks and business. Computer data also may serve the interests of military strategy, direct weaponry firings, and facilitate logistics. They also can be used to make medical diagnoses and voluminous scientific and engineering calculations—to list only a few of their potentialities.

Almost each application has specific requirements.

Selecting the right machines is like choosing the right man for a particular job. Organizations have spent millions through studies, experts, consultants, committees trying to find the right computer. Some have become so confused they either go ahead without a computer or choose quickly—often incorrectly.

The process of evaluating a computer for a particular application is extremely complex and typically involves some 15 man-years at an expense of five percent the machine's total cost.

As early as 1952, it became apparent to BRL that manufacturers had created such a myriad of names and characteristics that prospective users found it extremely difficult to select a suitable computer. To maintain full information on all extant and planned computing systems and components, BRL inaugurated a survey that would classify and compare all computers and describe their characteristics.

The survey, containing information on 84 machines, was published in 1955. Within one year, some 2,000 copies had been distributed to Government and industrial organizations by BRL as well as the Office of Technical Services, U.S. Department of Commerce, which sold reprints.

Within two years, the computer industry had expanded so rapidly that the 1955 survey was obsolete. A new survey uncovered high-speed circuits, rapid random-access storage, concurrent operation, application of polymorphic system concepts, printed circuits, nondestructive sensing, microminiaturization, automatic compilers and hundreds of other innovations. Martin Weik, who made the surveys, found 103 types.

Copies of the second BRL survey report were exhausted faster than those of the first. And again the Office of Technical Services and ASTIA reprinted and distributed thousands of copies.

In 1960 the Assistant Secretary of Defense (Comptroller) directed a third survey with the concurrence of the Bureau of the Budget and the U.S. Inter-Agency Automatic Data Processing Committee. That survey showed 222 different types of electronic digital computing systems. When the report was issued in 1961, the 3,000 copies printed by BRL were gone within a few months.

A survey in 1963 found 110 new types of computers had come into being, including the latest BRL innovation, BRLESC, which is the world's fastest program compiler and computer. The results are being compiled for publication.

The surveys revealed that the computer population was too unwieldly for effective choice by mere man. To get the job done in a reasonable time and at reasonable cost, BRL has automated the selection process so that computers can now select fellow computers for particular jobs.

All the data concerning the major characteristics for each computer have been coded and punched on cards. A computer program has been written which permits a prospective user not only to evaluate and select a computer for his needs, but also to allow BRL and other experts to find statistical distributions of features and thus determine trends for all types and models of systems.

BRL's influence is still felt in the industry it helped to nurture during the early years of growth to its present proportions of worldwide magnitude in shaping modern life.

Missile Command Hosts Design of Experiments Meet

More than 150 engineers and scientists from industry, the military services, Government agencies and educational institutions attended the recent Ninth Conference on the Design of Experiments in Army Research, Development and Testing.

Sponsored by the Department of the Army's Mathematics Steering Committee, the 3-day meeting at Redstone Arsenal, Ala., consisted of general, technical and clinical sessions. Presentations and discussions covered the broad areas of mathematics and statistics, with emphasis on RDT in the missile and space fields.

The Army Missile Command was host for the Conference which is an annual meeting called by the Army Research Office, Durham (AROD).

Brig Gen Howard P. Persons, deputy CG of the Army Missile Command for Air Defense Systems, welcomed the visitors. Col Nils M. Bengston, AROD commander, presided at the opening general session during which Dr. Frank Proschan, Boeing Scientific Research Laboratories, and Prof. Solomon Kullback of George Washington University gave key addresses.

Dr. Craig M. Crenshaw, chief scientist at the U.S. Army Materiel Command, Washington, D.C., addressed the banquet meeting and was introduced by John L. McDaniel, technical director of the Missile Command Directorate of R&D.

Other guest speakers included Dr. Churchill Eisenhart, National Bureau of Standards, Washington, D.C., Prof. H. O. Hartley, Texas A&M College, and Prof. David B. Duncan, Johns Hopkins University.

DESIGN OF EXPERIMENTS conference leaders relaxing during a coffee break are (l. to r.) Col Nils M. Bengston, commander of the U.S. Army Research Office, Durham, N.C., Dr. F. G. Dressel of his staff, Col Daniel F. Shepherd, head of Missile Command R&D Directorate, and John L. McDaniel.

Army Engineer Waterways Experiment Station Serves Broad Range of Civilian as Well as Army Objectives

In its broad program of R&D activities which have a secondary impact of vast importance to civilian requirements, the U.S. Army Engineer Waterways Experiment Station at Vicksburg, Miss., has gained unrivalled prominence.

WES scientists and engineers have nationwide and worldwide responsibilities in a broad diversity of effort. Among many organizations in which they serve are the International Society of Soil Mechanics and Foundation Engineering, and International Association for Hydraulic Research.

Col Alex G. Sutton is the WES commander and Joseph B. Tiffany is technical director of the laboratories.

Vicksburg personnel are well known for contributions to the work of the Quadripartite Nations on problems of roads, airfields, hardstands and trackways, and the test and evaluation of materials used in those facilities. They share in R&D on Corps of Engineers civil works responsibilities for harbors, waterways, navigation and flood control.

For example, one of the "small-scale" hydraulic models used by WES personnel to study navigation, flood control and water power of rivers covers about 220 acres and represents a Mississippi River watershed area of about 1,250,000 square miles.

The WES mission statement says: "It is engaged in research and engineering investigations in the scientific fields of hydraulics, soil mechanics, concrete, mobility of military vehicles, nuclear weapons effects, and flexible pavement design . . . provides consulting services in its specialized fields of competence, as well as a central scientific reference service."

Mobility, particularly off-road mobility, is to modern military requirements one of the most meaningful words in any language; depending on degree of effectiveness, often it means victory or defeat in combat. Military forces must be equipped to move expeditiously over any area, in any environment.

The WES Mobility Research Center is housed mainly in a single building with 30,000 feet of floor space. Mobility investigations seek knowledge on fundamental relationships between the vehicle and terrain conditions under which it must operate.

Findings, in the form of precise mathematical determinations where possible, serve as guides to military vehicle designers. The goal is a family of vehicles geared to combat conditions existing anywhere.

Among the newer vehicles whose design has been influenced by soils research are the Airall, Marsh Screw Amphibian, Meili Flex-Trac, Polecat and the Jiger. Engineered to meet exacting and peculiar military requirements, several of these vehicles may serve difficult terrain civil needs.

WES Organization. Established following one of the Nation's great disasters, the 1927 Mississippi River flood, the Waterways Experiment Station staff normally consists of about 900 civilian employees. They are assigned to three engineering research divisions—Hydraulics, Soils, Concrete—and to Technical Services, Construction Services, and Administrative Support.

The profiessional staff of about 225 is representative of all the major disciplines of engineering and the physical sciences—specialists in hydraulics, soil mechanics, concrete experimentation, electricity, electronics, and materials. Chemists, mathematicians, geologists, geophysicists and other scientists round out the staff. Leading consultants from universities, industry and professional life are employed by contract to enhance the range of WES capabilities.

Hydraulics Division. Functions fall into three major areas:

- Projects involving development, improvement and maintenance of waterways and harbors for navigation, flood control, power generation and other purposes.
- Determination of effects of nuclear explosions on waterways, terrain and structures by means of small-scale high-explosive tests, special laboratory tests, and theoretical and analytical studies, together with participation in full-scale nuclear tests.
- Development and standardization of design criteria for hydraulic structures through field tests of their performance, together with analyses of field experimental data.

Soils Division. Activities of this Division range an exceedingly broad area. Included are geological investigations, soil exploration and testing, design studies for earth structures and foundations, soils and foundation problems of missile base construction, development of expedient surfacing for roads and airfields, studies of landing field surface protection from downwash of aircraft propellers and from jet- and rocket-engine blast, and military mobility studies.

Concrete Division. Civil works activities make the Corps of Engineers perhaps the Nation's largest single construction agency, and one of the largest users of concrete. Investigations of the Division seek to advance concrete technology for construction as well as improvements in quality and reduction in cost of concrete.

Research includes chemical analysis, X-ray diffraction and spectroscopy, infrared spectroscopy, microscopy, effects of chemical agents, thermal and elastic property tests, strength tests, and reaction to controlled environments as well as natural weathering.

Technical Services. This Division provides capabilities for development, acquisition, operation and maintenance of complex instrumentation systems and devices required for measurement, control and recording of test parameters. Translating service is provided for foreign language engineering documents related to WES interests, and an extensive engineering library is maintained.

Dynamic Load Generator. Large-scale testing equipment is common at WES, but the largest facility, believed the only one of its kind in the world, is a massive dynamic load generator placed in operation in 1963. More than 3,000 cubic yards of concrete and hundreds of tons of reenforcing cable, rods and plates went into the facility. It is capable of simulating forces produced by full-scale nuclear explosions to test structures and structural components.

Nuclear Excavation Project. Potential peacetime uses of atomic energy being investigated by the Corps of Engineers include application of nuclear explosive force to large earth- and rock-moving operations. WES has been conducting this project for more than a year through the U.S. Army Engineer Nuclear Cratering Group, Livermore, Calif.

A recent report by W. E. Strohm, Jr., of WES states that among major problems involved in nuclear excavations are the effects of changes produced by such explosions in the engineering properties of cratered media, and the stability of the crater slopes. Studies seek to develop methods for evaluating stability of the slopes and the competence of material adjacent to the crater rim to support a wide variety of structures.

Field studies of nuclear craters and theoretical studies are involved in the project, requiring mobilization of

many technical capabilities of WES and other agencies. Major effort has been in the SEDAN crater in desert alluvium and the DANNY BOY crater in rock. Data from earlier crater experiments such as JANGLE U, TEAPOT ESS and the SCOOTER and BUCKBOARD series also were studied.

Preshot and postshot investigattions included borings to obtain general and undisturbed samples for study, geophysical logging of the borings, and geological field mapping to determine the distribution and character of the throwout and foldover materials.

Terrain Analyzer Project. Forests, rivers, steep slopes and other terrain conditions deterrant to the progress of military vehicles are easily identified from maps or conventional aerial photography. Ability of the soil to support the passage of a vehicle is not susceptible to accurate photographic analysis.

Consequently, the ultimate goal of the Terrain Analyzer Project is a capability to predict quantitatively the effect of terrain on military activities through utilization of remote terrain-sensor data. In effect, the project is divided into on-the-ground and airborne programs, and is separated into data-gathering and application phases.

Visualized as the end product of the research is an aircraft equipped with a multi-sensing terrain analyzer system capable of perceiving, registering and integrating data of the region over which it flies to permit the commander to make combat decisions based on accurate information.

WES researchers see in a remote sensing system that would meet military terrain analysis requirements many potential applications to civilian engineering requirements.

For example, it is anticipated that time required for determination of suitable routing for new highways could be substantially reduced. In its ultimate form, the system would minimize the need for core sampling and enable rapid determination of soil type, moisture and density.

Portable Surfacing Materials. Army Corps of Engineers development of portable surfacing expedients was started in 1939 when the Army Air Corps needed materials for emergency runway surfacings. WES has had a continuing responsibility for developing portable or expedient surfacing materials for airfields, roads and missile sites in areas that have to be prepared rapidly for use on a more or less temporary basis.

With the Army Materiel Command assumption of full operational responsibility in August 1962, the portable R&D surfacing materials program was placed under monitorship of the AMC although development of basic designs and engineering tests was continued at the WES.

Work has proceeded along two main areas of effort for a number of years. Mats of steel, aluminum, magnesium and plastic have had the stiffness which permits heavier loads to be applied to a weak subgrade. Flexible prefabricated membranes are designed primarily for waterproofing and dustproofing qualities on landing strips for aircraft or other military transportation needs.

Modified versions of perforated steel mats and an extruded aluminum mat have given improved performance in engineering tests and are undergoing service tests at military installations.

New types of membranes made of nylon coated with vinyl or neoprene also are being tested in the field at Fort Rucker, Fort Bragg and Fort Benning.

Engineers at WES point out that the R&D on both the rigid perforated mats as well as the waterproof and dust-preventive prefabricated mats intended for military use will have many civilian applications in construction work, logging operations and to prevent soil erosion.

Concrete Experimentation. The WES Concrete Division office and laboratory building at Vicksburg is a large structure that serves to indicate the importance of the Army R&D effort in this field.

Actually, Army Corps of Engineers personnel under the leadership of General Q. A. Gillmore won recognition for their research at the turn of the last century. Gillmore's test for time of setting of cement is still the standard as prescribed by the Federal Specification for Cement, Portland and for Other Types of Hydraulic Cement.

Army concrete research and testing have been centered at WES since 1946, and have been reported in hundreds of technical reports and articles published in professional journals. In October 1963 the president of the American Concrete Institute, Roger H. Corbetta, wrote to a WES staff member, saying in part:

"I have always had a tremendous respect for the Corps of Engineers. . . . I think you are fortunate to have had the opportunity of being identified with and being a part of the tremendous amount of work being done in concrete research by the Corps. . . ."

Two awards are made annually in the United States for contributions of outstanding merit in the field of concrete research. The Sanford E. Thompson Award of the American Society for Testing and Materials was awarded in 1953 and in 1961 to members of the WES staff. The Wason Medal for Research and the American Concrete Institute was presented to them in 1946 and 1954.

Hydraulic Research. The U.S. Army Engineer Waterways Experiment Station operates the largest hydraulic laboratory in the world. During more than 33 years of operation, hundreds of model studies have been conducted for the Corps of Engineers and other agencies for protecting harbors from storm waves, developing and improving inland waterways, preventing excessive silting in estuaries, testing flood control remedial measures, and related work.

Two current examples of this work are the Marina Del Ray model of a harbor three miles south of Venice, Calif., and a model of a ship mooring facility at Point Loma, Calif.

The hydraulic model of Marina Del Rey at Vicksburg was constructed by request of the U.S. Army Engineer District, Los Angeles. Modeled in concrete to an undisturbed scale of 1:75, it reproduced the entire harbor area, a portion of Ballona Creek, and Santa Monica Bay to the 60-foot depth contour. The model covered an area of about 15,000 square feet.

Machine-produced waves in the model, ranging from 1 to 20 feet in height, could be adjusted to specific desired frequencies, and could be simulated to reproduce those caused by shifting of winds in the area under study. Combined with the prototype wave study that was made in the harbor area by the Los Angeles Engineer District and the Beach Erosion Board, the findings were used to determine the most feasible corrective method of reducing the wave action to an acceptable level in construction started late in 1963.

The Point Loma mooring facility study is being conducted on a 1:100 scale model constructed of concrete to reproduce conditions of the mooring area, adjacent coast line and an offshore area sufficient to allow propagation of waves that normally occur. The model corresponds to an area of about 4.4 square miles in nature. A 1:100 scale model of an aircraft carrier is being furnished by the David Taylor Model Basin, a U.S. Navy facility in Washington, D.C., for the series of experiments.

U.S. Army R&D Traveled 'Rocky Road' to Reach Present Status

Army research and development might be termed, in the annals of history, "slow a-borning but prodigiously powerful in progress."

Consider that the title of Chief of Research and Development was not added to the Army General Staff until 1955. Review the long list of remarkable Army R&D "firsts" since then that have profoundly affected science worldwide. Ponderate on the 1964 Army R&D budget of slightly more than $1.4 billion.

Do those things and you may be tempted to join the ranks of those who resort to "fantastic, incredible!"

Today, Army R&D activities literally circle the globe, range the full scale of the scientific and engineering disciplines, and involve some 28,000 civilian employees (about 8,200 scientists and engineers) in addition to more than 12,000 Army officers and enlisted personnel.

Additional statistics involve about 435 major projects, some 1,300 tasks and several thousand subtasks. Current figures on the total number of activities participating in the Army R&D program, usually reflected in the Army Research Task Summary, were not available at press time.

The previous ARTS statistics showed about 75 Army in-house installations, 22 other Government agencies, 280 profit-making firms, more than 230 colleges and universities, and approximately 120 nonprofit research institutions.

Significant achievements of this vast effort provide the theme of this anniversary edition of the *Army Research and Development Newsmagazine*, and the contributions of various major installations are reported in separate articles.

Historically, Army research and development have traveled a hard road to achieve unquestioned recognition as an indispensable part of Army progress in the continuing struggle to keep military resources at peak power—superior to that of the potential enemy in any type of combat.

American soldiers landing on the beaches of Norway in 1944 carried but few weapons which would not have been recognized by their fathers in World War I American Expeditionary Forces. Only the bazooka and the tactical radios were really new. Rifles, machineguns, tanks, trucks and other materiel showed modest improvements.

Between those world-shattering struggles, military leaders were slow to acquire an appreciation of the importance of research and development to a modern Army, particularly of basic research to stock a "bank of knowledge." Even the exact time frame when the term research and development came into official usage in the Army is vague, but it was probably in the early 1920s.

The first Army Regulation dealing with R&D was not drawn until 1924. It dealt with R&D only as an incidental part of its theme, "Types of Equipment Used by the United States Army."

Responsibility, meager as it was, was delegated to the General Staff, requiring that "the various supply branches, in connection with the using branches, will conduct the development work necessary to produce articles meeting the prescribed requirements. . . ."

Changes to that Regulation in 1927, 1931 and 1936 evidenced the gradual evolution of high-level thinking toward the concept of R&D today.

The War Department indicated that R&D would not be limited to items for which requirements had been formulated and approved, and that (for the first time) "preliminary R&D work will be conducted in many cases without a clear idea of what ends may be attained. . . ."

Even here a word of caution was sounded, an admonition R&D leaders have repeated in more fanciful language through the years—But don't waste money!

World War II opened the eyes of military leaders to the vital importance of research and development when it brought forth new and revolutionary materiel, produced quickly with the aid of knowledge science had "banked" by research in earlier years.

Rapid emergence of Russia as a world power following World War II served no less effectively to direct attention to the need of the United States to step up the tempo of R&D effort, or face the risk of being bypassed along the path of scientific progress. Russia's intensity of effort was obvious.

On May 1, 1945, the Army published its first official policy on research and development, acknowledging not only the R&D contribution in World War II but envisioning potential for future conflicts.

That same spring General Eisenhower, then Chief of Staff, supported Army R&D in another formal policy statement to the effect that lessons of the late war should not be forgotten and that the pattern of integration of science and the military "must be translated into a peacetime counterpart. . . ."

The newly stated policy recognized that the Army had to have civilian scientific assistance in military planning as well as for the production of weapons. Also, that scientists had to have the greatest possible freedom for research. Further, that the military had to become fully aware of the advantages achievable from close integration of civilian talent with military plans and development.

Most importantly, the policy state-

Secretary of the Army Congratulates Newsmagazine

Since the *Army Research and Development Newsmagazine* was established three years ago, it has earned a warm welcome each month on the desks of nearly 34,000 readers, including scientists, engineers, technicians, and management officials at Army scientific activities in the United States and overseas as well as in other Federal Government agencies and in industry.

Conceived in response to a long-expressed need for improvement of informal communication within the Army scientific community and among governmental organizations directly or indirectly concerned with Army research, development, test and evaluation of military materiel, the magazine has admirably served that purpose.

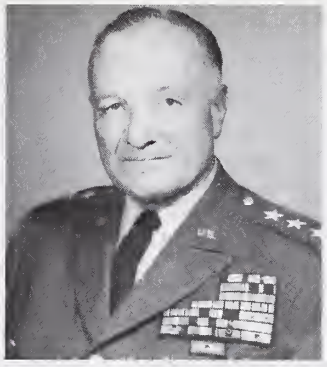
The broad range of information about the scope, program planning, progress and problems of Army RDT&E contained in each issue has earned an enviable reputation for the publication. The magazine has also served as one vehicle for Army participation in the current major effort being made by the scientific community to improve the collection and use of the mass of scientific information generated by the increase in research and development in recent years.

On the occasion of its third birthday, I take great pleasure in offering congratulations and best wishes for continued progress to the *Army Research and Development Newsmagazine.*

Cyrus R. Vance
Secretary of the Army

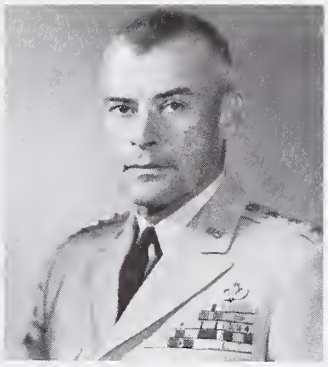
Lt Gen (ret.) James M. Gavin

After serving as the first Chief of Research and Development (1955-58) General Gavin joined Arthur D. Little, Inc., and became president in 1960. He left in 1961 to serve as Ambassador to France but returned to ADL in 1962 as president. He retains that post, is currently president of the Association of the U.S. Army, and recently accepted appointment as a consultant to the U.S. Army Scientific Advisory Panel. He is the author of **War and Peace in the Space Age,** *and* **Airborne Warfare.**



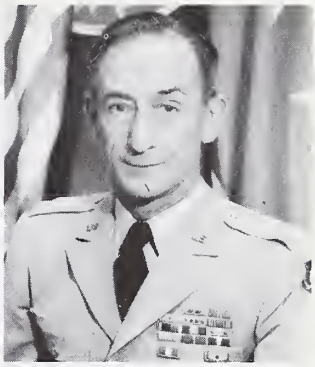
Lt Gen (ret.) A. G. Trudeau

When General Trudeau retired from the Army in June 1962, he terminated 38 years of military service culminated by more than four years duty as Chief of Research and Development, during a period when the program he directed gained vastly in size, complexity and expansion to many foreign countries. Since then he has served as president of Gulf Research and Development Company in Pittsburgh, Pa. In May 1963 he became a consultant to the Army Scientific Advisory Panel.



Lt Gen Dwight E. Beach

The policy of selecting leaders with distinguished combat records over long periods of military service to become Chief of Research and Development was continued when General Dwight E. Beach took over in June 1962 from General Trudeau, under whom he had served as deputy for 18 months. The untimely death of Lt Gen John P. Daley in July 1963 was followed by selection of General Beach as the new commanding general of Combat Developments Command, with headquarters at Ft. Belvoir.



Lt Gen William W. Dick, Jr.

Commanding General of the U.S. Army Air Defense Command was a title General Dick carried from May 21, 1962, until the unexpected events which returned him to Washington to succeed General Beach. From July 1960 to April 1961, when he was named to command the 3rd Infantry Division, U.S. Army Europe, General Dick had served as Deputy Chief of Research and Development under General Trudeau. Prior to that he had served nearly two years as Director of Special Weapons, Office of the Chief of R&D.

ment advocated separate responsibility for research and development from the functions of procurement, production and materiel distribution.

Action followed the words. Effective June 11, 1946, the Research and Development Division, War Department General Staff, came into being —a separate General Staff agency on equal level with agencies for supply, training and planning, personnel and intelligence.

The director of this R&D staff agency was given primary War Department responsibility in application of national resources in scientific research to the solution of military problems—for initiation, coordination and progress of the overall Army R&D program. He was the adviser to the Secretary of War on research and development matters.

Solid progress in the Army R&D program followed creation of the new division though considerable difficulty was experienced in building up a full head of steam. A continual struggle attended efforts to attract and retain the highly trained civilian scientists, engineers and management personnel needed to give the program sustained momentum.

Funding problems also hindered efforts. Uncertainties regarding sustained funding levels in various areas of the program tended to create a lack of confidence in the Army's ability to conduct a top-flight research

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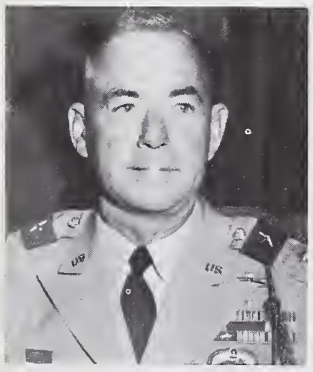


Lt Gen T. J. Conway

The U.S. Army Research Office was established in March 1958 and Lt Gen Conway, then wearing one-star rank, was appointed the first Director of Army Research. He had served with the Office of the Chief of Research and Development since 1955. Currently he is deputy commanding general, 8th U.S. Army, Korea. From June 1960 to April 1961 he was assistant commander of the 82nd Airborne Division, and then was division commander until July 1962 he was assigned as chief of JUSMAAG in Thailand.

Lt Gen William J. Ely

As the second Director of Army Research, Lt Gen William J. Ely served from March 1959 until April 1962, when he was assigned as deputy commanding general of the U.S. Army Materiel Command. Reassignment of Vice Adm Charles B. Martell set the stage for General Ely to succeed him in July 1963 as Deputy Director of Defense Research and Engineering (Administration and Management) and won him promotion to 3-star rank. Most of his military career has been in Corps of Engineers assignments.

Maj Gen C. W. Clark

Currently assigned as commanding general of the U.S. Army Japan, Maj Gen Clark was selected for that responsibility in August 1963 after serving since April 1962 as Director of Army Research. He followed General Ely and it was the latter's elevation to DDDRE that set in motion the chain of events that gave him his first major field command assignment. Maj Gen Jean E. Engler was relieved of command in Japan to succeed General Ely as deputy commanding general, U.S. Army Materiel Command.

Brig Gen Walter W. Lotz

The professional military scientist assigned to an important responsibility for management of Army R&D is typified by Brig Gen Lotz. He is trained for his Director of Army Research assignment as an expert in electronics, backed up by M.S. and Ph. D. degrees in physics. He was graduated from the United States Military Academy in 1938 with a B.S. degree and has held progressively responsible assignments in military communications. He was acting CG of the Electronics Command until reassigned to his present position.

Army R&D Traveled 'Rocky Road' to Present Status

(Continued from page 55)

effort that would properly utilize professional personnel and assure advancement of their scientific careers.

The Secretary of War attacked these problems in September 1947 by calling for a study which was made by Dr. Cloyd H. Marvin, scientific director of the Army R&D Division.

Dr. Marvin's report contended that the Army needed to change its R&D thinking and organization if it was to fulfill its mission, saying in part:

"Research and development is an attitude of mind, not an isolated prescribed administrative activity. Within the Army it can live only if supported by vision of the Army which sees the challenge of the future."

Integration of Army R&D with strategic planning was absolutely necessary, Dr. Marvin said, including a new staff structure which would emphasize the planning function of the General Staff with effective interaction between strategic, operational, logistical and research planning.

Changes in Army organization did not, however, occur in line with the recommendations of the report. In fact, the Army R&D effort suffered when Army Air Force R&D projects (originally two-thirds of the Army R&D dollar expenditure) were transferred to the new U.S. Air Force.

In December 1947 the Army R&D Division was abolished as a separate unit and redesignated the R&D Group of the Service, Supply and Procurement Division, General Staff.

Effected at a time when other Government agencies were giving greater freedom and prominence to their R&D staff groups, the Army change left the strong R&D organization advocates in at least a mild state of shock for a time.

In April 1950, the Secretary of the Army Gordon Gray ordered a formal study of the Army R&D organization and administration. The "Kilgo Report," delivered to the Secretary in January 1951, made some 20 recommendations to strengthen the Army R&D organization and management. Over a somewhat extended period, all of the recommendations were adopted, in some form or another.

Strong disagreement delayed action on two of the key recommendations, calling for establishment of an Assistant Chief of Staff for R&D and the creation of a Deputy Chief of Staff for Development.

Compromises worked out by Secretary of the Army Frank Pace and General Maxwell D. Taylor, then Deputy Chief of Staff for Organization and Administration, resulted in adoption of a plan in December 1951.

Research was added to the title of the Deputy Chief of Staff for Plans, and he was charged with assuring consonance of Army R&D activities with missions assigned by the JCS, war plans, and the latest tactical doctrine. A new position, Chief of R&D, in the O/CS, was responsible for Army Program No. 7, Research and Development.

The plan provided also that each of the General Staff agencies would have sections of varying sizes concerned with R&D in particular areas of cognizance. This was a concession to Secretary Pace, whose objective was to remove R&D from the Logistics field without setting up a separate staff division.

Further, the old R&D Division was retained in G-4 but its size was somewhat reduced and its authority and jurisdiction greatly curtailed. It was held responsible only for supervision of the development, execution and review-analysis of the material segment of the R&D program to include Technical Services R&D activities.

Secretary Pace followed the realignment of R&D functions by creating the Army Scientific Advisory Panel in November 1951. Coupled with the other advances, the establishment of the Panel of top scientists and industrial representatives served to indicate that Army R&D had moved ahead in integrated effort.

As was pointed out on the negative side at that time, the Chief of R&D lacked real executive authority and the decentralization of the various R&D components was to prove unde-

Missile Command Selects 2 For Administrative Awards

Outstanding junior and senior executives at the Army Missile Command recently received awards recognizing their work in the field of public administration at Redstone Arsenal, Ala.

John A. Robins, deputy project manager for the Army's Lance ballistic missile system, won the Senior Executive Award. Recipient of the Junior Executive Award was Donald R. Simms, a member of the Sergeant ballistic missile system procurement office. Honorable mention for the Senior Executive Award went to Neal E. Roberts, Directorate of Supply and Maintenance.

Maj Gen John G. Zierdt, CG of the Missile Command, presented honorary plaques. The executive awards are designed to give special recognition and encouragement to civilian personnel for exemplary achievement or notable contributions in the administration field.

Personnel under 36 years of age are eligible for the junior award; those 36 or older are eligible for the senior executive award.

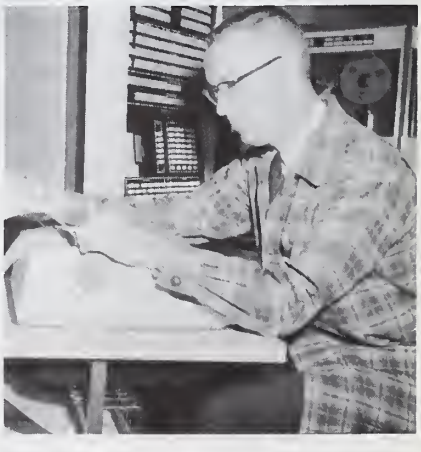
White Sands Names Deaf-Mute for Presidential Award

A deaf-mute mathematician rated as one of the top employees in the White Sands (N. Mex.) Missile Range Test and Evaluation Directorate was nominated recently for the Presidential Award as the Handicapped American.

Orville E. Northcutt was nominated by the Las Cruces, N. Mex., Committee on Employment of the Physically Handicapped, based on his continued noteworthy performance of assigned duties.

While praising the efficiency and dedication to duty of Mr. Northcutt, White Sands Missile Range military leaders and Civilian Personnel Office officials stressed that he is but one of 468 handicapped employees, many of whom hold responsible positions.

White Sands Missile Range has found, over the years, that disabled employees concentrate on trying to overcome their physical handicaps by superior mental application to duties. They are employed as engineers, chemists, mathematicians and in various semiskilled positions.



Orville E. Northcutt

sirable, in that no single agency could follow a project from beginning to end, but it was a step toward progress—the climax of vigorous give-and-take.

In June 1954, Secretary of the Army Robert T. Stevens proposed a reorganization that would have added two new assistant secretaries, one for Civil-Military Affairs, the other for Logistics, to include R&D.

Further, the plan provided for strengthening the position of Chief of R&D to give him authority to "stimulate, support and coordinate the planning and operational requirements for research and development."

Unfavorable reaction to Secretary Stevens' plan resulted in the transfer of R&D functions from G-4 to the Deputy Chief of Staff for Logistics. Positions of the Assistant Chiefs of Staff G-1 and G-3 were cancelled and functions were centralized in the Office of the Deputy Chief of Staff for Plans and Research. Actual control over the R&D elements of the Technical Services remained with the Deputy Chief of Staff for Logistics.

The stage was set for the major transition to the Office of the Chief of Research and Development as it exists today when Lt Gen James M. Gavin became Deputy Chief of Staff for Plans and Research in March 1955. By June he had decided that changes in Army R&D organization were needed, and he asked for recommendations for realignment.

The Hoover Commission Report had called for creation of an Assistant Secretary of the Army for R&D. Prevailing sentiment appeared to favor establishment of a Deputy Chief of Staff for R&D who would maintain close relationship with the Deputy Chief of Staff for Logistics to facilitate transition from development to production, and to work with the planning and combat development agencies of G-3 to facilitate R&D integration into war plans.

Chief of Staff General Maxwell D. Taylor approved a proposal to establish a position of Chief of Research and Development when a legal restriction prevented the creation of a deputy chief of staff for R&D. Lt Gen Gavin became the first "real" Chief of Research and Development Oct. 10, 1955. About the same time a position of Director of Research and Development was established.

Under the leadership of General Gavin and Lt Gen Arthur G. Trudeau, who succeeded him Apr. 1, 1958, Army R&D forged ahead rapidly—such achievements as the Free World's first satellite, Explorer 1, and the Free World's first operational intermediate range ballistic missile (IRBM), the Jupiter.

Important developments followed in quick succession, including the Free World's first recovery of live animals flown into space, and the first heat-protected nosecone recovery.

Still it soon became evident that in numerous instances the R&D process could be speeded up appreciably if the Chief of Research and Development were given more direct authority over the key personnel and installations being utilized by the R&D elements of Technical Services.

Fourteen recommendations covering all phases of Army R&D were drawn by the Army Scientific and Advisory Panel at a meeting in October 1958 and submitted to Secretary of the Army Wilber Brucker. One proposal was that the Chief of Research and Development be given sole responsibility for all R&D policy determination, that he control all funds essential for the conduct of R&D, and that he be authorized to contract directly for R&D projects.

Director of Research and Development Richard S. Morse, who succeeded Dr. W. H. Martin, the first incumbent, recommended to Secretary Brucker in the fall of 1959 that a study of the R&D structure be made in view of the changed conditions since 1955.

CRD Lt Gen A. G. Trudeau backed him, and in November 1959 Secretary Brucker appointed the "Roderick Board," headed by Asssitant Secretary of the Army for Financial Management G. H. Roderick.

The Board's report, approved by Secretary Brucker in July 1960, avoided major organizational changes. Instead, recommendations were made for numerous procedural changes to bolster materially authority of the Chief of Research and Development within the Technical Services.

In effect, the line of responsibility and authority between the Deputy Chief of Staff for Logistics and the Technical Services remained unchanged on matters of logistics. A parallel line of responsibility and authority was established between the Chief of R&D and the Technical Services on R&D matters.

General reorganization of the Army in 1962 abolished the traditional R&D materiel functions of the Technical Services, except for The Surgeon General and in some respects the Chief of Engineers. R&D materiel operational responsibilities were concentrated in the new U.S. Army Materiel Command.

Under the massive reshuffling of the traditional major elements of the Department of the Army, including actions affecting many thousands of personnel and the realignment of R&D functions, the Office of the Chief of Research and Development was relatively unchanged.

The Chief of Research and Development retained his title, with responsibility to the Chief of Staff paralleling the Deputy Chief of Staff for Logistics, Deputy Chief of Staff for Personnel, Deputy Chief of Staff for Operations, and other agencies.

That fact might be construed to mean that after years of controversy and many changes, the Army R&D Program is matured and relatively stable. But few wise in the ways of the Army would bet on that.

Lt Gen Dick Calls Newsmagazine 'Bonding Device'

With this issue the *Army Research and Development Newsmagazine* completes its third and most successful year. Its growth and acceptance by the scientific and industrial community and the contributions the magazine makes are extremely gratifying.

A constant need in today's world is to keep abreast of current happenings, whether it be news of international affairs, personalities, or scientific and technological advances. The *Army Research and Development Newsmagazine* fills a recognized need for coverage of Army R&D events, major personnel changes, as well as being a vehicle which provides a general awareness of the varied types of work being performed at the many and diverse Army R&D installations.

In addition to facilitating one's ability to stay abreast of events, the Newsmagazine serves as a bonding device between all individuals making up the Army's widely scattered R&D community.

The continued growth and demand for this magazine, from both military and nonmilitary agencies, reflect better than words its contribution and continuing value. We in Army Research and Development are proud of this magazine.

Lt Gen William W. Dick, Jr.
Chief of Research and Development
Department of the Army

CDC Role Shapes Army's Future in Land Warfare Spectrum

USACDC Headquarters consists of five directorates: Plans, Programs and Intelligence; Concepts and Doctrine Development; Materiel Requirements; Operations Research and Experimentation; and the Operations Research and Experimentation Directorate.

The Command is not much bigger than a single ROAD (Reorganization Objective, Army Division) Brigade. In fact, about 4,000 of USACDC's 6,000 strength is its 194th Armored Brigade, used for "live-testing" and validating tactical and organizational concepts at the Combat Developments Experimentation Center (DCEC) at Fort Ord, Calif.

As one of seven subordinate headquarters, the Center uses a 268,000-acre instrumented field laboratory at Hunter Liggett Military Reservation (55 air miles south of Fort Ord) for operations to validate doctrinal concepts. The Center also receives support from Stanford Research Institute of Menlo Park, Calif., which furnishes scientific services through its CDEC Headquarters Research Office.

The remaining six subordinate headquarters take a close focus on specific areas of combat developments. Some have subordinate to them additional field agencies which take an even finer focus on Arm and Branch needs in combat developments.

For example, the *Combined Arms Group* at Fort Leavenworth, Kans., working closely with the Command and General Staff College, deals with the objectives, doctrine tactics, and air defense of the Army in the field and has under it CD Agencies who work as Arm and Branch specialists.

The *Combat Service Support Group* at Fort Lee, Va., performs primarily the same function for the logistical and administrative support of the Army in the field, specializing on Communications Zone CD matters.

The *Office of Special Weapons Development* at Fort Bliss, Tex., heads the developments effort for the concepts, equipment and organization for the Army's use of and defense against nuclear weapons systems.

The *USA Institute of Advanced Studies* at the Army War College at Carlisle Barracks, Pa., takes the longest and broadest view of the Army in joint and theater-level strategic operations and studies to keep the design of the Army in step with national policy.

The *Special Doctrine and Equipment Group* shares part of CDC Headquarters at Fort Belvoir, Va., coordinating and expediting all combat developments relating to Special Warfare. SDEG has a subordinate field element — the Special Warfare CD Agency at Fort Bragg, N.C. — plus extensive liaison with the many other groups interested in this type of low-key warfare.

The *Command Control Information Systems (CCIS-70) Group* at Fort Belvoir is concerned with projecting and planning for requirements of the U.S. Army in the 1970s time frame.

During its first year and a half of operation, the Command has provided organizational guidance to the Army through TOE (Tables of Organization and Equipment) for the ROAD Divisions.

Other projects include RODAC-70 (Reorganization Objectives, Division, Army, Corps 65-70), CO-STAR (a logistical combat service support system for the Army), and Army-80 concept (very long-range Army forecasting concept).

In the doctrinal field, USACDC is supplying guidance for test and evaluation of the 11th Air Assault Division at Fort Benning, Ga.

In performing its hardware function, the Command has sought to relate more closely doctrine and materiel requirements and objectives. Thus, there has been a constant review of requirements with the goal of ensuring that the Army gets the maximum tangible increase in combat effectiveness from available resources.

USACDC's $25 million budget, therefore, cannot be used to measure its true impact on the Army or the civilian community since the most intangible asset of the Command is its imaginative people — the soldier-specialist teams who must know all the Army's Arms and services and their materiel requirements not only in breadth but in depth.

The U.S. Army Combat Developments Command (USACDC) can rightfully claim to be the Army's *smallest* major command—with the LARGEST effect on the Army's present and future in the spectrum of land warfare.

The Army's "Idea Proving Ground" was activated July 1, 1962 at Fort Belvoir, Va., as the focal point for all combat development functions formerly carried on by the U.S. Continental Army Command and the chiefs of the Technical and Administrative Services.

The USACDC was organized with the mission "to command all assigned field agencies; to formulate and document current doctrine for the Army, and, in anticipation of the nature of land warfare in the future, to determine the types of forces and materiel needed, and how these forces and materiel should be employed."

In brief, the Command is charged with answering three dominant questions: How should the Army be organized? How should the Army be equipped? How should the Army fight?

Under the command of Lt Gen Dwight E. Beach, former Chief of Research and Development, since Aug. 20, 1963, the USACDC conducts studies, tests, and operations research and proposes guidance for the Army's research and development efforts from "idea input" to procurement of hardware end-items needed to support their tactical and organizational concepts.

Whether the concept concerns a new squad or Corps, a simple vehicle modification or an entirely new weapons system, the mission remains the same: to assure that the concept is *needed* and will tangibly increase the Army's combat effectiveness in several reference-years, from today out to 20 years.

Army STINFO Division Serves Personnel by SCAN Reference

SCAN, meaning Scientific Current Article News, is a new publication of the Scientific and Technical Information Division of the U.S. Army Research Office in Arlington, Va.

Normally that information would be of interest only to Army Research Office scientists, engineers and management personnel because the publication is solely for their benefit. Other agencies, however, may like the idea, since it serves as a simple way of letting personnel know what may be of interest in periodicals.

SCAN is merely a stapled-together reproduction of the index pages of 15 to 20 publications dealing with the Armed Forces, management problems, scientific advances or national research and development objectives. Rapid perusal enables personnel to determine what articles are readily available to them in the U.S. Army Research Office reference library.

Army Engineers Nominated For 1964 Flemming Awards

Two Army engineers, Ralph E. Hopkins and John G. Armistead, have been nominated for the Arthur S. Flemming Awards to be presented in February by the Washington. D.C., Junior Chamber of Commerce.

Initiated by Arthur S. Flemming, former Secretary of Health, Education and Welfare under President Eisenhower, the awards are presented annually to five Federal Government employees in the scientific or technical fields and five in the administrative or executive fields. Candidates must be under 40 years of age.

HOPKINS, 39, was nominated by the U.S. Army Engineer R&D Laboratories (ERDL) at Fort Belvoir, Va., for achievements in the field of ultra - high - speed, high - frequency, electrical motors and generators, and the control techniques for them.

Ralph E. Hopkins

John G. Armistead

As supervisory electrical engineer in the Electrical Power Branch, he was awarded the Commanding Officer's Technological Achievement Award in 1963. The award is one of ERDL's highest honors.

Employed at the Labs since graduating from Ohio University in 1950, he has also received several Outstanding and Sustained Superior Performance awards. He now heads the Advanced Design Section of the Electrical Power Branch.

ARMISTEAD, 39, was nominated by the U.S. Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA) for achievements as senior resident engineer at a contract plant.

He received a B.S. degree in physics from Hampden Sydney College in 1949, and has been employed at Fort Belvoir since 1951. He is primarily responsible for development of a system that will give worldwide geodetic data for strategic missile programs and peacetime mapping.

Engineer Labs Develop Versatile Snow Plow Hitch

Specifications for a new, versatile hitch to eliminate problems associated with the procurement and troop use of snow plow equipment are being prepared by the U.S. Army Mobility Command Engineer Research and Development Laboratories.

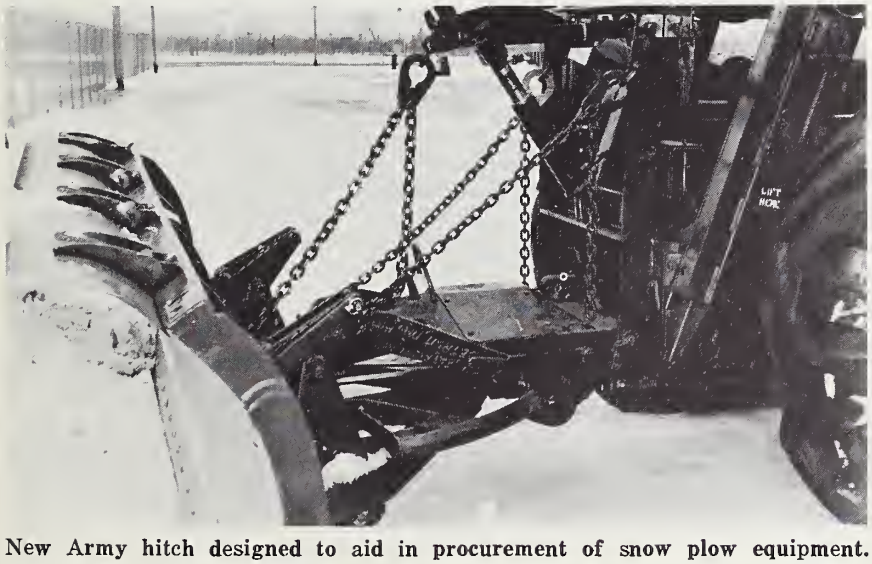
The hitch makes possible the purchase of "off-the-shelf" snow plows from various manufacturers. Heretofore, snow plows have been built to fit the hitch currently in use and in accordance with military drawings.

Designed for mounting on the front of Army and commercial trucks, 2½ tons and up, the new hitch can be used on the Quartermaster rough terrain forklift for snow removal.

The hitch has one hydraulic cylinder to raise and lower the plow, while the old type employed two. The new design has reduced the weight of the hitch and permits use of a lighter plow.

The approximate weight of the hitch and plow for mounting on a 2½-ton truck, for example, has been reduced from 3,300 to 1,700 pounds with a corresponding reduction in price to the Government.

A self-contained, battery-powered hydraulic system eliminates the need of modifying the vehicle in any way.



New Army hitch designed to aid in procurement of snow plow equipment.

2 APG Employees Presented Meritorious Service Awards

Meritorious Civilian Service Medals, the Department of the Army's second highest civilian employee award, were presented recently to William A. Gross and Harold A. Noble, Aberdeen Proving Ground, Md.

Both men are employees of APG Development and Proof Services. Maj Gen James W. Sutherland, Jr., CG of the U.S. Army Test and Evaluation Command, cited Mr. Gross as a recognized leader of automotive test activities, with particular reference to his aid to NATO groups.

General Sutherland commended Mr. Noble for the unique method he applied in assembling test data which contributed first to Jefferson Proving Ground's outstanding wartime record, and more recently has been a key factor in maintaining the Army Materiel Command's test program at Aberdeen P.G.

Jefferson P.G., near Madison, Ind., conducts production engineering and surveillance trials.

The Human Touch in Electronics

Technicians' Skilled Hands Shape Major Advances

The human touch in electronics, despite the advance of automation, is not likely to become obsolete. That is the considered opinion of a man representative of a nimble-fingered group of technicians at the U.S. Army Electronics R&D Laboratories, Fort Monmouth, N.J.

Edmund E. Malecki is a scholarly looking man of 50 who assembles microminiature electronic parts — many of them now so tiny they would tax the capability of highly skilled watchmakers, and still being reduced.

Machines have taken over the work of many similarly skilled precision craftsmen, Malecki is the first to admit, but he believes the demands upon the gifted fingers of electronic technicians grow ever more complex.

In fact, under questioning, he will venture so bold as to state that without the trained fingers of electronic craftsmen many of the marvels of the electronics world never would come into being. Individual skills are basic to assembly of components.

In Mr. Malecki's operations, for example, his standard of measure is a mil (one-thousandth of an inch) and it is not unusual for him to measure in small fractions of a mil. To get the right magnification, he often fits a 6-power watchmaker's compound lens over his mild reading glasses. Sometimes he depends on a 30-power microscope.

Other tools he uses include an assortment of watchmaker's tweezers, micrometers, optical gauging projectors, some jigs for conveniently holding tiny electronic objects, and some extra small soldering irons.

Little more than a decade ago, electronic engineers computed that about 10,000 was the top figure of parts that could fit into one cubic foot.

Today, the Electronics Laboratories regularly achieve 500,000 parts per cubic foot in advanced circuitry. In same cases the figure reaches 1,700,000. By 1965, engineers foresee a parts density of several million parts a cubic foot. Over a longer range, the outlook verges on the incredible.

"Engineers here are not seeing how many parts can be packed into a cubic foot just for the fun or novelty of it," Mr. Malecki explains. "Without small parts, some of the things we're doing today with electronics would be impossible, or impractical.

"For example, some computers would have so many circuits they would be as big as a ranch house. Rockets and satellites would not be able to carry enough different kinds of equipment to do all the things they are called upon to do. Soldiers are using more and more electronic equipment, and they still have to carry a lot of it on their backs."

Edmund Malecki delicately adds etched "wafer" diode to micromodule already comprised of another diode, three transistors and inductor. The micromodule shown can do work of nine regular electronic components.

You might say that Mr. Malecki came to his present profession honorably, or at least traditionally. His grandfather was a watchmaker in Poland. His father (deceased) followed the profession when he came to the United States. A brother is a watchmaker and repairman in Chicago. And Malecki learned the art in his father's Pittsburgh shop.

After majoring for two years in chemistry while attending college, Malecki worked in two Army hospitals and became chief technologist in the medical labs. Then the hospitals changed over to military technologists about 12 years ago.

Malecki thought about his watchmaker skills in relation to the developing electronics industry, and in 1950 started his career with the U.S. Army Electronics R&D Laboratories.

"I've learned a lot about electronic principles since then," he comments, "but can still say, scratch a watchmaker and you'll find the making of an electronic technician."

Malecki's fine hand has helped make Space Age history. He and other USAELRDL technicians helped build the jewel-like tape recorder that was used to store messages from one ground station and play them back to another when SCORE, the world's first communication satellite, went into orbit on Dec. 18, 1958.

"Virtually all of the work we do here at the Laboratories is connected with research and development of new items," he likes to emphasize. "After all the problems have been worked out and something new goes into mass production, a lot of the hand work is usually over. But that doesn't bother me. By that time we have started on something else."

Picatinny Employee Hikes Income by Suggestions

Alex Kepler

Suggestion of money-, labor- or time-saving ideas has proved a lucrative source of additional income for Alex Kepler, a 40-year veteran of Government service currently employed at Picatinny Arsenal, Dover, N.J.

Ranked among the all-time high winners in the Army Incentive Awards Suggestion Program, Kepler has received cash awards for more than 35 acceptable ideas. In 1963 he capitalized on an ancient trick of housewives and suggested the use of broom handles wrapped with clean rags for high overhead cleaning.

Picatinny's 60 suggestion boxes turned up 1,554 ideas—described by reviewers as "some fresh, some not so fresh, and some too ripe to mention"—during the past fiscal year. Only 338 were accepted.

Francis Costanzo came up with an ingenious approach to the problem of picking up heavy flat wooden boxes off freight cars and trucks. He won an award for a lifting device employing the principle of ice tongs.

The top money award of $1,000 went to David Walters for his suggestion to build and use a manual ejector for a grenade launcher. It is estimated that the idea will save the Government $70,000 in a year of operation.

Total estimated savings of the suggestion awards program at Picatinny during FY 1963 were set at nearly $400,000. Ideas paid employes $18,623.

Experts Gather at Food Science Research Conference

Army food research teams and cooperating scientists were praised and challenged during the Nov. 19-21 Food Science Research Conference at the U.S. Army Natick (Mass.) Laboratories.

More than 400 representatives of industry, research organizations, universities and Government gathered at the Army Materiel Command's Natick research center to learn of new developments and progress in food research and allied fields.

Thirty-four speakers discussed food science and its contributions to military needs, food industry capability in military preparedness, food preservation and microbiology, processing and packaging rations, and the latest research challenges relating to stress, human behavior, nutrition, and creation of food structure and flavor.

Maj Gen William P. Yarborough, commanding general of the U.S. Army's Special Warfare Training Center at Fort Bragg, N.C., praised food scientists for their work and challenged them to solve the feeding requirements unique to guerrilla warfare—the need for more compact, nutritious rations.

Astronaut John W. Young (Lt Comdr-USN), monitor of food developments for possible space flight use, said the state-of-the-art for freeze-dehydrated foods could now satisfy the ration needs for short-term (7-14 days) space flights. He noted that critical weight requirements dictate compactness in rations.

The 33-year-old astronaut said that the closed regenerative ecological systems now under study would not become essential parts of life supporting systems until space flights are 300 days or more in duration.

The conference was sponsored by the U.S. Army Natick Laboratories, the National Academy of Science-National Research Council, and the Research and Development Associates.

GORID Telescope Undergoes Final Tests at WSMR

GORID, a telescope with an 18-inch aperture and focal lengths up to 500 inches designed for tracking and filming hypersonic missiles in flight, is undergoing final evaluation tests at White Sands Missile Range.

The acronym stands for Ground Optical Recorder for Intercept Determination, and the system is intended to record the position of high-altitude vehicles on magnetic tape ready for feeding into a computer.

GORID thus will eliminate one big step, that of processing film and reading it before it can be fed to computers in the form required by missile designers. The system is capable of picking up every aspect of a missile's journey and giving an accurate and complete picture of its performance.

Before GORID can perform as a precise theodolite, it is necessary to know and record the mislevel of the instrument. This is done by a unique mercury pool-capacity electronic device designed and developed by White Sands Missile Range engineers. The device records its information (accurate to one second of arc) onto the magnetic tape with precise timing.

By tightening tolerances of both optical and mechanical design, the WSMR engineers were able to provide a telescope having many new features while maintaining theodolite accuracy. The GORID has selectable focal lengths from 90 to 500 inches.

The telescope has additional features including automatic refocusing of the telescope optics using radar slant-range information. It also has automatic exposure control which assures properly exposed film.

Special attention was given in design and fabrication to mechanical and optical alignment and rigidity. The result is a system with exceptional ability to distinguish a target and record images with little distortion while maintaining precise theodolite optical alignment during tracking.

The data recorder is a 70 mm. full-frame camera operated at selected synchronous frame rates of 10 to 80 frames per second.

GORID, Ground Optical Recorder for Intercept Determination at WSMR.

TECOM Sponsors Meeting On Desert/Tropic Testing

The first Combined Desert/Tropic Planning Conference, sponsored by the U.S. Army Test and Evaluation Command (USATECOM), was held Dec. 3-6 at Aberdeen Proving Ground, Md. The purpose was to plan for 1964 tests at Yuma Proving Ground, Ariz., and the U.S. Army R&D jungle experimental center in Panama.

More than 65 delegates from 50 test agencies, commodity commands of the U.S. Army Materiel Command, and Panama R&D Office attended.

Desert and tropic test groups combined efforts for the first time in joint session to prepare for environmental phases of engineering, design and service tests on Army equipment and the conduct of troops under simulated combat conditions.

Combining tropic and desert test organizations as one conference group is expected to reduce costs, eliminate an excess of paperwork and bring the problems of both test units into single perspective.

Maj Gen James W. Sutherland, Jr., CG, USATECOM, opened the meeting by outlining tasks confronting the groups. He stressed the importance of proper and timely advance planning to the successful conduct of environmental testing.

Col Robert D. Larson, CO, U.S. Army R&D Office, Panama, used films in a talk to pinpoint environmental areas where tests of materiel will be concerned mainly with the effects of weather and deterioration caused by termites, microbes, mildew and jungle and sand areas.

"Far from the least of our concern," he said, "is the constant analysis of heat, cold and general health considerations as they affect the health and well-being of the soldier who may ultimately be called on to use the weapons we test."

Military materiel discussed included field artillery, flash and sound and survey equipment, radar, fire-control equipment, free rockets, cannon, ammunition and missiles.

Other speakers discussed armor systems and associated weapons, field equipment, individual airborne equipment and medical items, communications and electronics surveillance, target acquisition and radar equipment, air-delivery equipment, CBR items, warheads, and general purpose and other vehicles used primarily by engineer, quartermaster and transportation units.

Col Roger H. Hemion, chief of the USATECOM Headquarters Test Analysis Office, coordinated plans for the conference.

Nth Order Effects of Government Support of Research

By R. G. H. Siu

The basis of the following article was first presented by Dr. Siu as a speaker at a June 14, 1963 seminar held in Durham, N.C., under the sponsorship of the U.S. Army Research Office-Durham (AROD).

* * *

Dr. Ralph G. H. Siu

"Superlatives are synonymous with Siu" is an opinion fellow scientists and a great many friends have for the author of "T-Thoughts," the column that adds sprightly humor to this periodical each month.

Vastly respected as a scientist of top stature, famed for his pioneering efforts in the Army food preservation by irradiation research program that has generated worldwide interest, Dr. Ralph G. H. Siu is no less well known for his work in many other fields of Quartermaster Corps endeavor.

"Scientist-scholar" is a term that has been applied to him on almost countless public speaking appearances. Honors have been heaped upon him for his scientific achievements. Leading professional journals have published a long list of his scientific articles. But he is perhaps most affectionately regarded for wit.

Associates speak of him as a man who "never lets his dignity get the better of him." The tension of many a spirited scientific discussion has been dispersed by a pithy comment linked to his irrepressible humor and a gift for the perfect citation from the great philosophers to apply to the situation.

The National Civil Service League selected Dr. Siu in 1961 to receive one of its 10 annual Career Service Awards. That recognition came to him after 19 years of Federal Service, starting with duty as an assistant chemist in the Department of Agriculture in 1944.

The following year he began a mutually happy association with the U.S. Quartermaster Corps—terminated only by Army-wide reorganization in 1962, resulting in transfer of QMC materiel functions to the new Army Materiel Command. Currently he is technical director of the AMC Research Division. From 1953 to 1962 he was technical director, Army Quartermaster Corps.

A concrete embodiment of an old abstract argument may be taking place today with profound social consequences. The philosophical controversy involves the question whether or not quantitative changes can bring about qualitative ones.

From a practical standpoint, the transition may be regarded as the point at which latent effects begin to demand attention. An important transformation of this nature is becoming visible as a result of increasing Government support of research and development.

The impact of the Federal outlay upon the American scene can be appreciated from facts and figures.

The United States Government will spend about $100 billion next year. About one out of every seven of these dollars will be expended on research, development and testing of technological innovations. The Defense Department alone is currently spending about $7 billion a year on R&D.

About 70 percent of the $2 billion annual research and development budget of American universities is provided directly by the Federal Government. As high as 60 percent of the total operating costs of individual universities comes from Government sources, not counting such indirect benefits as tax credits.

Sizable fractions of the total are spent in large research centers. Forty percent goes to 35 Government-owned, university-operated installations such as the Argonne National Laboratory, Jet Propulsion Laboratory, and Los Alamos Scientific Laboratory. Most of the funds go to the larger schools. Sixty-eight percent is allotted to 25 universities.

A comparable influence is exerted upon industry. It is not rare nowadays to find companies with about half of their total income being derived from research and development contracts; a large proportion of this comes from the Government. The controversy surrounding the newest experimental tactical fighter plane, TFX, clearly shows the nature of competition involved in some cases.

All in all, about three-fourths of the total research and development expenditures for the whole country are provided directly or indirectly by the Federal Government.

This generous support of research and development gave rise to the major technological advances of today, impressive even to the casual observer. These represent the readily apparent first-order effects of Government patronage of research. The results had been knowingly contracted for by the Government and other sponsors. They had been openly agreed to by the scientist and engineer in the laboratory. Three examples may illustrate the genesis and nature of such first-order effects.

The first example is taken from the area of natural resources. It is expected that based on our present state of knowledge, the United States either has available within her own boundaries or can gain access to sufficient quantities of food, clothing material, water, energy and space to continue to improve the standard of living with increasing populations for at least 50 years.

In 1961 only 304 out of 638 million acres of high productivity were planted. Only nine percent of the labor force was required to produce the needed amount of food. By 1980 only 297 million acres, using only six percent of the labor force, would be needed, producing a 40 percent increase in crop yield. Beyond the year 2000, however, it may be necessary to have much faster growing varieties of plants and animals.

Research grants and contracts are therefore being awarded in plant and animal genetics and breeding. The resulting scientific information and new varieties of plants and animals represent first-order effects of the sponsorship of research by the United States Department of Agriculture.

The second example is drawn from the electronics industry. With increasing demands for international communications, new devices with much higher capacities for handling messages in undersea cables are required. A new amplifier, transmitting 128 telephonic conversations simultaneously in two directions and requiring no maintenance for 20 years, represents a first-order effect of the support of research by the Bell Telephone Laboratories.

The third example comes from basic research in biochemical genetics. Considerable progress has been made during the last two decades on the mechanism of transfer of characteristics from one generation of organisms to another. The National Sci-

ence Foundation and other agencies have been supporting work along this direction. One of the latest resultant theories is quantum genetics.

According to this hypothesis, the genetic information is coded in the coils of the DNA molecule itself, as influenced by the proton position in the hydrogen-bonding between the paired DNA molecules. These protons obey quantum laws. Occasionally these wave packets spread through potential barriers to unlikely positions, thereby bringing about mutations, which are responsible for evolution. This genetic model of the quantum-mechanical tunnel effect in solid-state diodes represents a first-order effect of the Government grants in basic research.

With the generously increasing support of science and technology over the past several decades, higher-order effects are becoming visible. These are the changes brought about by money expended for research and development which have been covered neither in the scope of the contract or grant, nor in the expressed purposes of technical studies involved.

No one has explicitly or implicity planned for or against occurrence of these changes. They do not come into consideration in the formulation of overall programs for Government support, in the allocation of specific grants, or in the solicitation of such assistance on the part of industry and universities. No one and no agency can be held responsible. No one and no agency is assuming the responsibility unto himself or itself.

Seven examples of such higher-order effects are described in the following paragraphs.

Change in the Character of the American University. Prior to the forties, nearly all of the research in American universities, except agricultural studies in land-grant colleges, was carried out by the academic departments. There was no dean for research, no research coordinator, no vice president in charge of research, no research contracting officer.

With the increasing involvement in research supported by outside funds, various changes occurred. Progressively larger numbers of full-time research associates were added to the academic departments. This was accompanied by more cohesive groupings of outside sponsored research activities in the form of institutes, as integral parts of the university, such as the Anthropoid Center being set up in California.

At the same time heavy capital investments were made, which require continued support, such as the Illiac high-speed digital computer at the University of Illinois.

Universities were no longer reluctant to manage Government-owned, university-operated centers such as Brookhaven National Laboratory. At the same time, affiliation with nonprofit research organizations, such as Armour Research Foundation and the Stanford Research Institute, became accepted practice.

The previous loose administration of research in universities could not cope with the far-flung activity. A more formal organizational structure appeared, involving contract attorneys, negotiators, public relations experts, and an administrative hierarchy. Because of the presence of organized centers and project teams, personnel with managerial competence became important on campus.

These are the people who can manage complex multi-million dollar organizations, who can weld diverse talents into directional programs, and who can maintain appropriate contacts for the required funds, personnel and awards. In many institutions these personalities have begun to replace the scholar in international prestige. The tone of the campus is reflecting this emphasis from the scholarly to the managerial.

In addition there is an emergence of a "research community" drawing its support from nonacademic sources. A growing concern is in evidence regarding the fraction of the university's energies that should be apportioned for such "noninstructional" activities. A minority favors divesting the campus of all research institutes and reverting back to the earlier system of academic departments.

By and large, however, faculty members argue that the best education is associated with the best research, and that a strong research effort on the campus is necessary for a strong educational program. The situation is still in a state of vigorous contention. The question, "How much research is too much?" is unanswered.

Change in the Place of Universities in the Community. With two decades of academic experience in large-scale technical projects, and with the return to its campus of professors who have whetted their appetites in the action whirl of World War II, the university has become a reservoir of technical and executive talent for nonacademic exploitation.

There is the call for technical coordinators in organizing international programs, such as the International Geophysical Year. There is the demand for managers of affiliated research institutions, such as the Applied Physics Laboratory of The Johns Hopkins University. There are the financial lures of industrial consultancies, such as the 700 university consultants used by American Telephone and Telegraph Co. in 1960.

Efforts have been made to facilitate these relationships, such as the 115-acre campus of the Illinois Institute of Technology being located adjacent to a 50-acre industrial research park. A move on the part of universities to tie closer with the outside world of practical affairs is thus evidenced.

Meanwhile, industry and the Federal Government are moving toward the direction of research of an academic type. The abundance of available funds for research has made it possible for a series of interesting experiments in the industrial support of basic research. Many companies are now maintaining central research laboratories, in which quite fundamental thinking is going on.

The Government laboratories themselves have become a significant contributor to science and technology. Some of their advanced research rivals the best of academic centers.

In view of these trends, the difference in research competences and orientation between the universities and the rest of the community appears no longer a qualitative affair but rather a quantitative one. One is no longer surprised nowadays to hear of a Nobel laureate from the industrial world. No longer is the university the sole preserve of the "lone wolf" pioneer. Equally "lone wolves" roam the research realm outside the Ivy walls—although admittedly not many as yet.

Conversely, no longer is the university faculty member regarded as a naive academic scholar. Practical business minds function within the Ivy walls—again admittedly not too many as yet. But the qualitative separation between the two sides of the academic fence has been demolished. How far the diffusion process will go and what the equilibrium constant will become, no one can say.

Decrease in Intellectual Influence of Academic Presidents and Deans. In their sponsorship of research, Federal agencies have been very careful not to "control research." Yet the very facts of Federal appropriations require that judgment be exercised in the selective distribution of research funds among the many requesters.

Partly in a desire to be above suspicion, partly in response to the professional custom of being "evaluated by one's peers," and partly in an honest attempt at the best decisions in public interest, Government agencies have resorted to the use of advisory panels in many cases.

Composed predominantly of university personnel, these panels are understood to be advisory. Nevertheless their evaluations do constitute one of the most important factors in determining whether or not a given professor receives research support.

This evaluation system creates an interesting situation. The research being undertaken by a professor on Campus A is dependent for support, to a considerable extent, upon opinions of a group of professors on Campus B, C, D, etc., and vice-versa. The type of research is not as much dependent, as it once was, upon the presidents and deans of the various universities.

The question arises, as to whether there has been a significant erosion of university presidential leadership in developing the character of the educational system. Some observers liken the present dilemma to that in the story about the 1848 uprising in Paris. A person saw his friend tagging along with a mob about to storm a barricade. Knowing that the troops behind the barricade were well-armed and seasoned, he urged his friend to get back from the crowd. Whereupon his friend replied, "I can't. I'm their leader!"

Increasing Acceptance of Thinking as an Article of Commerce. The offering of one's creative talents for monetary returns has been an age-old practice. On the whole, the exchange of intellect and creativity for money during the earlier days had been relatively subdued. The transactions were conducted quite demurely.

During recent decades, however, there has been a greatly increased number and fervor of organizational representatives "selling," so to speak, their intellectual prowess to the highest bidder. The problem to which the talent is to be devoted, or the sponsor for which the work is done, often appears to merit only secondary consideration.

A pertinent example of the extent of commercial traffic in thinking is a fair size industrial subsidiary set up with the expressed purpose of doing basic research at a profit on the free market. Although the concern is doing quite well at the present time, it is difficult to say whether or not this precedent will develop into a major trend.

Another concept regarding the place of basic research in the scheme of things is being explored by some people. The idea has not gained much support at the present time, nevertheless, it is significant as an indication of the kind of change that may be taking place in the American attitude toward basic research. The funding plan divides research activities into two categories, namely:

- Those devoted to the fulfillment of stipulated materiel systems or social needs, which lie within the possibility of our current knowledge.
- Those devoted to the fulfillment of stipulated materiel systems or social needs, which lie beyond the possibility of our current knowledge.

According to this scheme of management, advances in fundamental knowledge will no longer be recognized as an approved objective for explicit support. Instead they are to be achieved as a derivative fall-out of the second category. This exemplifies an extreme reaction to the art-for-the-sake-of-art thesis of the Romantic Period of history.

Creation of a New Avenue of Power. Because of the sheer magnitude of the money involved and because of the important economical and international ramifications of research findings, scientific advisers have been offered an unparalled opportunity for political power.

In some respects, this recalls the observation of Heinrich Heine on writers in 1852. He referred to the passage in Hugo's **Notre-Dame** in which Frollo held a huge book in his hands and, pointing to the towers of Notre-Dame, said, "This will annihilate that! The press will supersede the padre." Lemoinne later said the same thing about newspapers when he stated that "the Journal will supersede the Parliament."

Heine commented that "if these hopes, even irrationally, are beginning to inspire men of intellect—which of them, do you think, will spend his time stringing rhymes, weaving novels and romances, when he can aspire to rule national masses of men?"

Great writers have continued to appear since 1852, despite Heine's fears. Nevertheless, a new social power—that of the political press—has become a reality. Whether or not a comparable power of political chemists, political physicists, and other political scientists (of the new technological vintage) are here to stay in today's world is not clear at present.

More Influential Role of the Government in Intellectual Fashions. Quite apart from the size of patronage, the selection of the intellectual problems to be pursued and the determination of areas of exploration thrusts Government into a new role.

In this connection, the legend about America's first Nobel laureate may be of worth relating. In contrast to other professors, Dr. A. A. Michelson was said to have been not too enthusiastic about graduate students. He was supposed to have expressed the feeling that the incompetent students would only bungle the fine research problems delineated for them; the more capable and successful ones, however, would inevitably fail, in their conceit, to recognize the importance of the proper problem selection on the part of the professor.

It is true that most of the research problems being undertaken under Government sponsorship have originated from the university and industrial workers themselves. Nevertheless, the Government is now involved in the formulation of research problems and in the definition of new investigational salients to a much higher degree than ever. This is tantamount to setting the intellectual fashions of the day—something new in the recent evolution of Government leadership.

Change in Value Preferences in the American Society. The above events cannot help but exert considerable influence upon our value norms. Formerly, thinkers in the field of philosophy, ethics, and social studies set the pace on questions involving norms. **De facto,** however, today's guidelines seem to be influenced more by the market of exchange, the financial rewards, the prizes, and the psychic compensations. The skewed support of the sciences in the universities, the junior science fairs, the greater outlet for jobs in fields related to research being supported by Government funds—such factors have greatly increased the attractiveness of the physical sciences as a way of life. This higher-order effect of research affluence has been discussed repeatedly in other articles and needs no repetition in this essay.

It may well be that the higher-order changes, brought about perhaps only indirectly by liberal Government sponsorship of research and development, constitute an inevitable evolution in the technological phase of man's historical development. The issue may not be a matter of choice.

Nevertheless, the scholar and scientist may ask himself a crucial ques-

tion regarding the preservation of his own values and attitudes. The seeker after enlightenment, who carries on in his own chambers unstrutted by the resources of the Government and other public sources of revenue, may continue to preserve his traditional freedom from financial auditors, program reviewers, and other interlocutors of society. Few will begrudge him the accoutrements of the classical academicians.

The majority of the scientists, however, are faced with a more difficult choice. Their fortunes are tied to the new research affluence. They hope and strive to preserve their former prerogatives. But a new issue has emerged onto the public plane: Should a person who has extended his influence to the social sphere retain the privileges attendant to his activities when they were more personal and private in consequence?

The debate will continue long and loud. But the eventual outcome appears reasonably certain, if society at large is to have the say. It may not please many a sincere scholar and scientist as a mark of progress.

Oh Man! Could You Ever Suspect . . .

'Multilith Multiplication' Would Pay Off Big?

Presentation of the Army Commendation Medal, the Army Good Conduct Medal and an order effecting his separation from active duty in the Army, plus the affectionate farewell kisses of a line-up of lovely secretaries, all came within a matter of hours recently to an "opportunist."

"Multilith multiplication" is the way friends explained honors and congratulations that were heaped upon Sp/4 Walter G. Hellwig when he terminated 18 months of duty with the U.S. Army Research Office, Office of the Chief of Research and Development, in Washington, D.C.

Many an adventurous young man in similar circumstances might have accepted assignment to the monotony of running a multilith machine as only slightly less desirable than continuous KP duty—particularly since it frequently involved virtual double-shift hours. Sp/4 Hellwig accepted the job as an opportunity to make friends by ever cheerful service.

"Crash" deadline requests for high-level documents reproduction came to Sp/4 Hellwig almost as a matter of daily routine, usually carried from the top bosses by the lovely young ladies who served as secretaries. No matter how much overtime duty might be involved (strictly on printing of course!) Specialist Hellwig could be counted on to fill the bill.

Consequently, when that long-awaited day for return to civilian life arrived, more than 30 of the ladies were on hand at a farewell party to demonstrate their esteem—along with Army Research Office male personnel, officers, enlisted men and civilians, who shared that friendly feeling.

Director of Army Research Brig Gen Walter E. Lotz presented the Army Commendation Medal and the Army Good Conduct Medal to Specialist Hellwig. A procession of the ladies followed, each to present a gift and a kiss.

Sp/4 Walter G. Hellwig, flanked by Assistant Director of Army Research Col Charles B. Hazeltine, displays his U.S. Army Commendation Medal.

The citation accompanying the Commendation Medal states in part:

"Specialist Fourth Class Walter G. Hellwig, US54332401, a member of Headquarters, United States Army Research Office, Office of the Chief of Research and Development, Department of the Army, performed his duties as an offset printing and reproduction services specialist in an exceptionally meritorious manner during the period 16 May 1962 to 22 November 1963. . . .

"The continuing demonstration of skill, enthusiasm, diligence and initiative in performance of his duties is especially noteworthy in view of the magnitude, complexity and high-level impact of the majority of assigned tasks. His dedication and devotion to duty reflect the highest credit upon himself and the United States Army."

By Ralph G. H. Siu

STAUNCHY DEFENDERS. The potpourri of arguments that seems to be the regular fare in Washington—allocation of money, personnel, floor space, contracts, awards and what-nots—reminds me of William Penn's observation:

Truth often suffers more by the heat of its defenders than from the arguments of its opposers.

THREE IN THE MORNING. The readiness to criticize on the part of some people and their ease of being satisfied reminds me of an old parable.

To wear out one's spirit and intelligence to unify things without knowing that they are already in agreement—this is called "Three in the morning."

What is meant by this?

A keeper of monkeys said that for their rations each monkey was to have three nuts in the morning and four at night. But at this the monkeys were angry. Then the keeper said that they might have four in the morning and three at night. And with this arrangement they were all well pleased.

HUMPTY DUMPTY. It must be exasperating to some people trying to ferret out duplications in research! To them, so much looks alike. Yet the scientists say not. Years ago, Humpty Dumpty faced the same kind of dilemma.

"I shouldn't know you again if we *did* meet," Humpty Dumpty replied, in a disconnected tone, giving her one of his fingers to shake; "You're so exactly like other people."

"The face is what one goes by, generally," Alice remarked, in a thoughtful tone.

"That's just what I complain of," said Humpty Dumpty. "Your face is the same as everybody has—the two eyes, so—" (marking their places in the air with his thumb), "nose in the middle, mouth under. It's always the same. Now if you had two eyes on the same side of the nose, for instance—or the mouth at the top—that would be *some* help."

ENERGETIC? It has been said some men have a reputation of being energetic when they're only nervous.

Army Announces Contracts Totaling More Than $155 Million

A $45,282,583.64 firm, fixed-price contract, awarded to Chrysler Corp. for production of 1,200 M114A1 armored reconnaissance carriers and 428 M109, 155 mm. self-propelled howitzers, topped the list of recent R&D contracts for material and services amounting to over $155 million.

Two fixed-price incentive contracts totaling $31,829,641 were awarded to the Raytheon Co., Lexington, Mass., for work on the Hawk missile system.

A $13,296,923 contract for production of 104,000 M-16 rifles (85,000 Army and 19,000 Air Force) was awarded to the Colt's Patent Fire Arms Manufacturing Co., Inc., of Hartford, Conn.

Called the AR-15 by the manufacturers and the M-16 by the Army, the new rifle will be used to equip special units. No decision has been made to supplant the M-14 currently in the hands of troops.

The new arm is a gas-operated rifle, chambered for the 5.56 mm. cartridge, and equipped with a 20-round detachable magazine. It is capable of automatic or semiautomatic fire, with a muzzle velocity of 3,250 feet per second.

Equipped with an in-line plastic stock, the lightweight M-16, weighing 6.90 pounds (loaded with 20 rounds), is the same weight as the M-14 when empty. The barrel length is 20 inches and overall length 38.8 inches, including attachment of a flash suppressor.

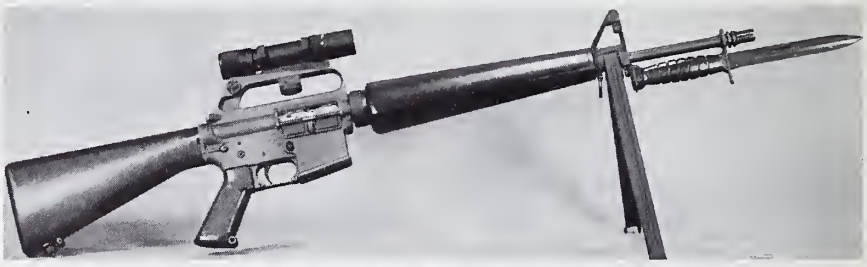
Defense officials say the M-16 will cost 30 to 35 percent less than the M-14 and that the ammunition saving is even greater.

A $13,391,872 contract to C. H. Leavell and Co. and Peter Kiewit Sons Co., El Paso, Tex., is for second-stage construction of the Saturn test facility at Hancock County, Miss.

Five contracts totaling $10,653,447 were shared by United Tractor Co., Inc., Chesterton, Ind., $2,049,317 for 824 warehouse tractors; Clark Equipment Co., Battle Creek, Mich., $1,876,768, Otis Elevator Co., Cleveland, Ohio, $2,675,498, and Towmotor Corp., Cleveland, Ohio, $4,051864—all for forklift trucks.

Technical Materiel Corp., Mamaroneck, N.Y., received a $4,759,450 contract for single sideband communications equipment for the U.S. Navy. The contract was awarded by the Electronics Materiel Agency, Phila., Pa., a field activity of the U.S. Army Materiel Command.

Chrysler Motors Corp., Detroit, Mich., received contracts for $4,434,160 for the production of 3,005 sedans and $1,453,646 for 9,990 cargo pickup trucks. Chrysler Corp's Air Temp Division of Dayton, Ohio was awarded a $1,431,803 contract for M60 main battle tank components.



Production of 104,000 M-16 rifles, as shown, will cost $13,296,923.

Communications and electronics equipment contracts were awarded to Sylvania Electronics Systems, Needham, Mass., $5,000,000, and Bendix Corp., Radio Division of Baltimore, Md., $1,000,000.

TMC Systems, Inc., Alexandria, Va., received a $3,764,085 contract for transportable communications equipment; Collins Radio Co., Richardson, Tex., a $2,509,860 definitive contract for 16 AN/TRC-90B sets for ground communications; and LFE Electronics, Boston, Mass., $1,935,-835 for aircraft navigational system.

General Motors Corp., Detroit, Mich., received contracts of $1,371,-128 and $1,985,278 for diesel engines for Army combat vehicles. The Allison Division of GM, Indianapolis, Ind., was awarded $2,928,653 for 1,364 geared-steer units for the M114A1 armored personnel carrier and related parts.

Ammunition contracts were awarded to the Beech Aircraft Corp. and Cessna Aircraft Co. of Wichita, Kan., and to the Emtex Division of Missile Systems Corp., Corrollton, Tex., for $3,277,711, $3,288,109, and $2,637,540, respectively.

The Chaney-James Construction Co. will receive $1,508,000 for work on the propulsion wind tunnel at Arnold Engineering Development Center, Tullahoma, Tenn.

Additional contracts include: Western Electric Co., N.Y., $4,161,246 for Nike Hercules modification kits; Firestone Tire and Rubber Co., Akron, Ohio, a $1,696,835 modification for shoe assembly rubber tracks for the M48 tank; Ford Motor Co., Dearborn, Mich., $1,346,151 for 563 trucks; and White Motor Co., Lansing, Mich., $4,585,324 for 2½-ton trucks.

Pershing Scheduled for USAREUR in Near Future

Deployment of the Pershing missile system to the U.S. Army in Europe is scheduled to begin early in 1964, following highly successful field test firings from August to November impacted at White Sands Missile Range, N. Mex.

As part of the Army's continuing program of modernization, the solid-fuel missile system will gradually replace the liquid-propelled Redstone missiles that have been operational by U.S. Army, Europe since 1958.

Designed to support a field Army, the Pershing is a selective range weapon capable of carrying a nuclear warhead 100 to 400 nautical miles. Labeled a shoot-and-scoot missile because of its ability to move quickly, it can be transported overland by its own tactical vehicle or airlifted by the Army's Chinook helicopters.

During the November tests troops operated under simulated tactical conditions. Under the supervision of the U.S. Army Artillery Board, the tests were conducted by the 2nd Missile Battalion of the 44th Artillery from Fort Sill, Okla.

Six mid-range service tests were pot, near Gallup, N. Mex., two from Fort Bliss, Tex., and the five longest firings from Black Mesa, near Blanding, Utah.

Army officials reported that the results of the latest firings sustained the long record of reliability the Pershing established during developmental tests at Cape Canaveral, Fla., under direction of the U.S. Army Missile Command, Redstone Arsenal, Ala. The Pershing is credited with the most successful record of any missile fired on the Atlantic Range.

Development of the 2-stage ballistic missile system is under direction of Col Edwin I. Donley, Pershing project manager at the Missile Command. The system has been developed under contract with the Martin Co.

Leaders Discuss Military Materiel Deterioration

Ways to minimize damage totaling billions of dollars annually were discussed at the recent 12th Annual Research Conference on Prevention of Microbiological Deterioration of Military Materiel, at Natick, Mass.

More than 60 leaders participated as representatives of the U.S. Army, Navy and Air Force and governmental agencies in England and Canada. Sessions provided a workshop for researchers to exchange knowledge, discuss cooperative programs, and review the scope of international activities to find more effective control measures.

Dr. Arthur M. Kaplan, head of the Fungicides and Germicides Laboratory at the U.S. Army Natick Laboratories, presided as chairman.

Discussion covered deterioration of petroleum fuels and products, handling equipment and storage facilities as well as cellulosic textiles, coated fabrics, rubber, plastics, wood, paints, paper products, and optical, electronic and communication equipment.

Among the agencies represented in addition to the Natick Laboratories were: Chemical Inspectorate, Royal Arsenal, Woolwich, England; Admiralty Materials Laboratory, Dorset, England; the National Research Council of Canada; Materials Laboratory, U.S. Army Tank-Automotive Center;

Aerospace Medical Division and Research and Technology Division, Wright-Patterson Air Force Base; Chemistry Division, Naval Research Laboratory, Pitman-Dunn Laboratories, Frankford Arsenal; U.S. Army Chemical R&D Laboratories, Edgewood Arsenal;

Prevention of Deterioration Center of the National Research Council; Quality Evaluation Laboratories, U.S. Naval Ammunition Depot; U.S. Army Biological Laboratories, Fort Detrick, Md.; Plastics Technical Evaluation Center, Picatinny Arsenal.

U.S. Army R&D Office, Panama; Army Research Office, Washington, D.C.; Materials Research Laboratory, Engineer Research and Development Laboratories, Fort Belvoir, Va.; Biological Sections Branch, Limited Warfare Laboratory, Aberdeen Proving Ground, Md.; Directorate of Research and Development, Redstone (Ala.) Arsenal; and Rock Island (Ill.) Arsenal.

Pilot Test Planned in Spring On Tri-Service Supply System

A pilot operation designed to test the feasibility of consolidating existing Army, Navy, Air Force and Defense Supply Agency administration of supply contracts in a 5-state area is scheduled to begin this spring. The headquarters for the test operation will be in Philadelphia, Pa.

According to the Department of Defense, the chief purpose of the consolidation is to increase post-contract supervision through the application of uniform procedures. Currently, the three branches of the Armed Forces maintaining contract supervision in the 5-state area use individual procedures.

If the pilot operations result in the expected increase in efficiency, other consolidation will be put into effect throughout the country, where 444 field organizations with almost 43,000 personnel are functioning.

Redstone Engineer Gets First General Toftoy Award

An Army Missile Command engineer engaged in exploratory research in Laser technology at Redstone Arsenal, Ala., is the first recipient of the General Toftoy Award.

The Alabama Section of the American Institute of Aeronautics and Astronautics recognized William A. Davis, Jr., at an awards banquet. Maj Gen H. N. Toftoy (Ret.), a former CG of the Arsenal, made the presentation. The award honors his contributions to Army rocket and guided missile development.

Davis is chief of the Special Programs Section, Future Missile Systems Division of the Directorate of Research and Development and was selected for the award by a panel of scientists headed by Rodney D. Stewart, Marshall Space Flight Center.

The Toftoy Award was established to supplement the Hermann Oberth and Martin Shilling Awards, presented by the AIAA in recognition of individual accomplishments. It will be made annually for work in technical management of important programs in aeronautics and astronautics.

A native of Nashville, Tenn., Davis is a 1950 graduate of Vanderbilt University with a B.S. degree in mechanical engineering. After graduating, he accepted a position with the Charleston Naval Shipyard as a general engineer. Four years later he transferred to Redstone Arsenal as a supervisory Ordnance engineer.

In 1956 he was selected for a position as an aircraft development control engineer in the Hawk Project Office for the Army Rocket and Guided Missile Agency. When the Army Missile Command was created in 1960, Davis was named a supervisory general engineer in the Future Missile System Division, the position he now holds. He is responsible for the Army Missile Penetration Aids Program and the Missile Command Laser Program.

Since 1961, Davis has been engaged in research activities pertaining to the Laser program and has been cited by both the Department of Defense and Department of the Army.

William A. Davis, Jr.

SCIENTIFIC CALENDAR

International Symposium on Radioactive Isotopes in Clinical Medicine and Research, Bad Gasten, Austria, Jan. 8-11.

Symposium on Charge Transfer Complexes, sponsored by AFOSR, Denver, Colo., Jan. 19-21.

International Conference on Semiconductor Applications, London, England, Jan. 20-30.

Commonwealth Conference on Corrosion, Kanpur, India, Jan. (date undetermined).

International Symposium on Modern Methods of Analytical Chemistry, Baton Rouge, La., Jan. (date undetermined).

International Congress on Scientific-Technical Documentation and Information, sponsored by the National Productivity Council, Rome, Italy, Feb. 2-11.

International Conference of the Impact of Modern Physics on Materials, sponsored by ASTM, Philadelphia, Pa., Feb. 3-.

ARO Working Group on Computers, sponsored by AROD and the U.S. Army Mathematics Steering Committee, Washington, D. C., Feb. 5-7.

International Solid State Circuits Conference, sponsored by IEEE and the University of Pennsylvania, Philadelphia, Pa., Feb. 12-14.

International Symposium on Metals for Ues at High Temperature, N.Y.C., Feb. 17-20.

International Conference on Transmission Aspects of Communications Network, London, England, Feb. 24-28.

Aerospace Bearings Symposium, sponsored by the Aeronautical Systems Division and the Southwest Research Institute, San Antonio, Tex., Feb. (date undetermined).

Picatinny's Lone Woman Chemist Mixes Pyrotechnics

When she was a little girl, Virginia Hogan was satisfied when she knew what made something "tick." Some years and two degrees in chemistry later, Virginia is satisfied when she knows what makes it go "boom."

An attractive brunette, Miss Hogan is the only woman research chemist at Picatinny Arsenal in Dover, N.J.—the Army's vast munitions installation where some 2,000 scientists and engineers are engaged in research and development.

Virginia specializes in pyrotechnics, developing new formulations for use in conventional ammunition and for missile and space applications. She is concerned with obtaining basic knowledge of fuels and oxidants.

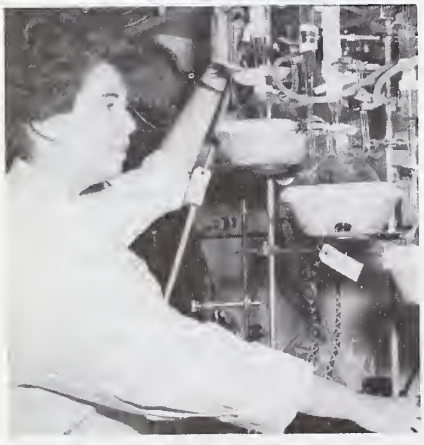
Pyrotechnics can be defined as a science applying physic-chemical reactions between intimate mixtures of finely divided oxidants and fuels for the production of noise, heat, smoke and light of various colors and spectral characteristics.

Among the pyrotechnics developed at Picatinny are photo flash bombs, flares, signals, smokes, tracers, illuminating shells and spotting flares.

Despite their extensive use in World War I, pyrotechnic devices before 1920 were appropriately classified as "fireworks" rather than "ordnance" because of their improvised and fragile construction.

After World War I, when funds for research and development of ammunition were reduced, most of the work in pyrotechnics had to be confined to the improvement of compositions.

Development of the tank, bombing plane, long-range artillery, and other vehicles and weapons increased the need for pyrotechnic ammunition, especially for reconnaissance and tactical purposes.



Virginia Hogan

With the advent of the space age, pyrotechnics is playing an increasingly important role for spotting and tracking devices on rockets and missiles and recovery operations. Some of the new uses and those proposed for the future, which are well clothed in security, require new knowledge.

Virginia Hogan works in her "ivory tower" of basic research, keeping up to date on these new requirements. Although her work is theoretical and basic, she is not "off in the clouds." As a matter of fact, the results of her work have immediate applications.

Specifically, the areas she is concerned with are investigations of self-propagative reactions between oxidants and fuels, pre-ignition studies of pyrotechnic systems, and results of defect structure on the chemical reactivity of pyrotechnic ingredients and compositions.

Many of her studies have been published and distributed to military and industrial organizations throughout the country. In collaboration with other Picatinny scientists, Virginia has prepared nine technical papers on basic research in pyrotechnics.

Virginia holds a B.S. degree from St. John's University, Long Island, N.Y., and an M.S. from Fordham. She is a member of some of the top science societies in the country, including the American Chemical Society, American Association for the Advancement of Science, and the American Ordnance Association.

Attesting to her ability and standing among scientists, Virginia Hogan's biography may be found in *Leaders in American Science.*

Vehicle Land Navigation System Passes USARAL Tests

Land navigation equipment to aid combat soldiers in movement over difficult terrain in northern latitudes successfully completed initial tests conducted recently by the U.S. Army, Alaska, Combat Developments Agency.

Mounted on a combat vehicle, the system continuously enables the driver to report his position and direction of travel quickly and accurately without the aid of landmarks.

The system consists of a power supply, a gyro compass, a heading and position indicator, a computer and a map-plotting board. The computer receives direction input from the compass and distance data from the vehicle's odometer. The map plotting board shows the vehicle position and direction of travel with a lighted dot and an arrow. The map scale can be changed by flipping a switch.

According to Jack F. Angel, USARAL Combat Developments Agency project officer, the system is the best answer yet for an immediate fix on "Where am I? All you need to know is where you are when you start and the point of your objective. The system automates the work for you."

During the USARAL tests, the system was used on M-116 amphibious cargo carriers and M-59 personnel carriers manned by soldiers of the 1st Battalion, 60th Infantry (Mechanized), 172nd Infantry Brigade. Vehicle operators moving at night through heavily wooded areas were able to respond quickly to commands for direction changes.

"Using the system," reported Capt Angel, "soldiers were able to reach objectives during the night with remarkable accuracy."

Upon the completion of the tests, USARAL Combat Developments Agency received permission to retain the equipment for further evaluation because of the great need for such a system in Alaska. The system will receive further extensive testing during the 1964 Alaskan Command Winter Training Exercise.

The Land Navigation System was developed by the Canadian Army Equipment Engineering Establishment, Ottawa, Canada, in consultation with the U.S. Army Engineering Research and Development Laboratories, Fort Belvoir, Va.

Besides Alaska, the system is undergoing tests at the U.S. Army Armor and Desert Training Center, Fort Irwin, Calif., and in Europe.

Canadian Army S/Sgt Fred G. Parsons explains operation of Land Navigation System, mounted on an M-59 carrier, to USARAL officers.

Electronic Sentries Yell 'Help'

Missile Command Adds Magic Eyes to Call Guards

Classified secrets at the U.S. Army Missile Command, Redstone Arsenal, Ala., are guarded by sentries that don't carry guns, walk a post or even wear a uniform. They just yell for help with an electronic voice.

In fact, they are so alert that they are apt to yell if a mouse scampers across the floor or wind blows through an open window.

The sentries are electronic instrusion detectors that listen for sounds, watch for motion and squawk if a door is opened or a window raised when it isn't supposed to be.

About 80 percent of the areas which contain the Army Missile Command's classified documents and missile hardware have been protected to date by the device which is the electronic age's answer to the old-fashioned clanging burglar alarm.

An intruder may never know that he has been detected—at least he may not know it for two or three minutes. That's about the time it takes for alerted armed and uniformed security police to have him surrounded.

Security is an important matter at the Army Missile Command. Most of the Army's missiles are developed here and work is done on projects so sensitive that the outside mention of their real name is forbidden. Code names are used.

To protect its documents and classified hardware from compromise, the Missile Command resorts to elaborate precautions.

The intrusion detection systems are a good example of these precautions. They do not replace human guards, but, instead, supplement them. This allows the security police, as the guards are called, to be instantly mobile to converge on a violated area.

The sound detection system can detect a man walking across a floor or opening a desk drawer. The electromechanical switches installed on doors, windows and other openings send a tell-tale signal when one of them is moved.

Most sensitive of all are the motion detectors. This uncanny device is so touchy that its senses have to be purposedly dulled to prevent it from sending "nuisance alarms." This is done by setting the sensitivity of the device so normal air currents in the building do not cause a false alarm.

The ones at the Missile Command are adjusted so that if an intruder even breathes deeply while he is in the beam, he is caught. It has sent guards rushing to a building only to find the alarm was triggered through an open window.

The devices bounce inaudible sound waves between a transmitter and a receiver, covering a broad area. Anything that moves in the path of the waves sets off the alarm.

When an intrusion detector "hits the panic button," it is heard in a small windowless room at security police headquarters. A gong rings, a light flashes to indicate the area, and a meter shows approximately what part of the area was disturbed.

The security policeman on duty speaks to a radio operator, giving the location. The radio operator, with his fingers on every roving patrol car, flashes the information. In minutes they converge on the spot.

Chances are that the intruder is a janitor late in going about his duties or a forgetful employee who has returned to pick up something from his desk. On this security-conscious Arsenal, however, the police may be courteous—but they don't laugh.

Camera Repair Man Surmounts Handicap of Blindness

Bill Howard's friends have a saying: "He's not handicapped. He's just blind."

Despite the fact that William B. Howard works in perpetual darkness of total blindness, he has created for himself an enviable reputation of being one of the finest camera repairmen at the Army Missile Support Command at Redstone Arsenal, Ala.

Howard's work with high speed, delicate camera cogs is difficult and demanding at its best. But, as he puts it, "You don't really have to see a camera to work on it — provided your sense of feel and hearing are good enough to serve as your eyes."

Howard's fellow workers at the Maintenance Support Division of the Army Missile Support Command consider him an exceptionally courageous man. Though he lost his eyesight at the age of 15, he is far from the type individual who is content merely to sit behind a work bench: he has developed still another remarkable skill.

He designs his own tools for use in his delicate work on special high speed cameras, some valued in the thousands of dollars. Howard's self-styled tool kit contains about two dozen precision instruments—all conceived and tailored to do a specific job on a particular camera.

Howard's repairs of a wide variety of complicated cameras have won for him the reputation of being one of the finest craftsmen at Redstone.

"But I could never have done it without the help of others," he emphasizes.

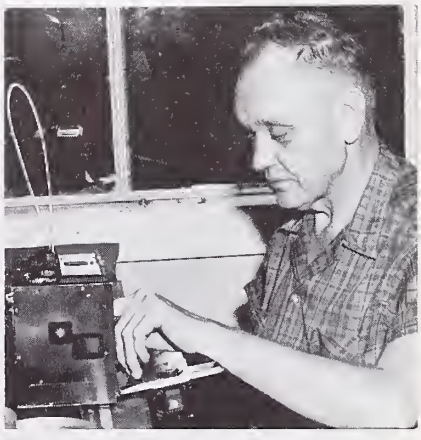
For example, Howard points to an engineering technician in the Missile Command's Test and Evaluation Laboratory who makes his tools after the camera repairman describes what type instruments he wants.

Howard's supervisors are free-wheeling in their praise of his work, particularly his ambition. Said one:

"He used to study electronic courses during his lunch hours; we did everything we could to help him, but he didn't need much help. Just steer him in the right direction, and he'll make it from there. Let him drop a pin-size screw and his ears tell him exactly where to pick it up. And with his extraordinary sense of feel, he has no difficulty in finding the right one."

He has been at the Army Missile Command for 10 years. Before coming to Redstone, he was a small arms repairman at Anniston Army Depot, Ala. He learned the craft of repairing small arms with the aid of friends who assisted him in mastering the basic principles. He attended the Alabama School for the Blind for eight years.

Howard resides at 302 Green Cove Road, Huntsville, Ala., with his wife, Floda Mae, and a 16-year-old son.



William B. Howard

Newsmagazine Lists Highlight Articles Published in Past Year

Publication in the year-end edition of the Army Research and Development Newsmagazine a complete index listing of all possibly significant articles published during the year is admittedly desirable. That would require more space than is here available. The following is a listing of those believed of broadest interest.

DEC. 1962–JAN. 1963 —

Army Regulation 705-25 stresses materiel reliability.

DoD Directive No. 5100.36 states policies on technical information.

Walter M. Carlson appointed as Defense Director of Technical Information.

NSF Survey shows R&D 1963 Funding may hit $14.7 billion—an increase of $3.5 billion over the R&D expenditure in FY 1962.

Army Mathematics Center announces 1963 schedule of activities.

Army plans field test of 57-pound portable X-ray unit developed by the U.S. Army Medical Equipment Research and Development Laboratory.

AEC, DoD and NASA announces establishment of a program office for the development of a space reactor.

SATCOM Agency will send signals through 22,300 miles of space to activate and test NASA's SYNCOM satellite.

A model of the SM-1, the original land-based military nuclear power plant, was transferred to the Smithsonian hall of nuclear energy.

Army materiel leaders discuss plans for conducting the standardization program within the new Army organization.

Redstone chemists grow precious gems for use in Army Laser research.

QMREC developing "Tilt" cargo parachute release device to eliminate damage to loads dragged by parachutes.

DoD Directive 4000.20 prescribes a uniform system of designating rockets and guided missiles.

Dr. Howard gives views on management responsibilities in Army RD laboratories.

Armed Forces Institute of Pathology celebrates its 100th Anniversary.

MH-1A pressurized-water, floating nuclear power plant design added to the Army Nuclear Power Program.

FEBRUARY—

ASA (R&D) approves the Army Scientific and Technical Information Program.

Dr. Ernst Weber is the new Chairman of the Advisory Council of the U.S. Army Junior Science and Humanities Program.

Sending: An SOS for Society of Solid "Squares."

National Referral Center for Science and Technology cites aims.

"Angry-106" is the first Army jeep radio to provide dependable 50-mile voice communications even over severe terrain obstructions.

Additional policies for support of ARPA outlined in a new TAG letter prepared in the Research Programs Office, USARO.

Army Foreign Science and Technology Center established.

EJC announced a program designed to improve the engineer's utilization of technical literature and application of information processing systems.

Army Research Institute of Environmental Medicine reports on discoveries that will provide adequate protection against heat, cold.

Secretary Vance extends ROAD concept to all Army elements.

Aberdeen uses radiosotopes as materiel testing tool in difficult problems.

Prototype testing of the world's smallest nuclear electrical power plant, the mobile ML-1, resumes under AEC-Army Nuclear Power Program.

MARCH—

Army Research Office alters Divisional structure; establishes Office of the Director of Army Technical Information.

The Army STINFO Program, approved by the DDRE as a well-considered plan for an aggressive attack on problems, is being set in motion.

Nationwide growth of the U.S. Army JSHS Program will reach a 5-year peak with the First National JSH Symposium.

Advanced Technology Group experiments on resolving specific scientific, technical problems.

Science, Government, and Information is the recently issued report of the President's Advisory Committee.

Microminiaturization successes win Army scientist Flemming Award.

ARTS, Technological Forecast, Contractors Guide and *Problems Guide* being revised.

WRGH physicians have converted a method of detecting cancer to a method of treating the disease.

D/A plans to form new assault and support units to test and develop further the air mobile concept for ground combat.

Army preparing film to stimulate greater interest in research on fuel cell power.

An exploratory program seeks better use of national technical societies and associations in Army research.

USAMC and USACDC Memorandum of Agreement on Research and Development identifies their responsibilities and procedures.

CSC Hall of Fame exhibit shows incentive awards inventions.

Construction started on $3 million research building at USACRDL, Edgewood Arsenal.

Redstone Arsenal scientists develop a pure fluid valve for missiles.

Irradiated bacon is the first milestone of the Army's 10-year food radiation research.

Army R&D leaders favor postdoctoral program expansion.

Project HARP conducts first firings in upper atmosphere probes.

Helicopter landings at South Pole accent Army aviation role in Antarctic.

APRIL—

U.S. Army Materiel Command Advisory Group (MAG) for improved management.

OCRD announces new procedures for Army Reserve R&D Training Units.

ASTIA rounds out 10 years service and is redesignated the Defence Documentation Center for Scientific and Technical Information.

Transfer of Information linked to research and development.

APRO demonstrates the Army Automatic Rating Machine.

Low altitude Meteorological research project set for Barbados, W.I.F.

Dr. Nathan Marcuvitz appointed as Assistant Director of Research, DDRE.

Establishment of the Interagency Chemical Rocket Propulsion Group approved by DoD Instruction 5030.24.

Floating laboratory tracks missile nosecones for ARPA's Project DAMP.

Nation's largest solar furnace tests QM materials.

Stabilization in personnel initiated in RDT&E programs.

Defense Electronics Director informs IRE group of DoD efforts to resolve radio frequency interference.

DDRE memorandum stresses objectives of research, engineering and management.

Development program aimed at broad use of gas turbines.

Army support added to NSF-I through Reserve R&D Training Units.

MAY—

Army announces selection of 19 for R&D Achievement Awards.

Fuel cell electric power research achieves a major advance.

Vice Adm Charles Martell appointed as Chairman of the President's Committee on Scientific Information.

Army R&D expenditures and industry planning.

CRD to sponsor Eighth Tripartite Conference in Washington, D.C.

New data preparation system will be used for the ARTS.

U.S. Army studies human factors research cooperation with Australia.

ASAP member advocates R&D tours for Reserves.

DoD officials participate in the Eighth Institute on Research Administration.

Army Natick Labs Set Up Post-Doctoral Program

A Post-Doctoral Program benefiting U.S. military research and illustrating American international scientific cooperation has been established by the U.S. Army Natick (Mass.) Laboratories.

Four scientists from Japan, Australia, England and Germany will work for one year, under the supervision of top staff members, assisting in specific military research projects at Natick, a field agency of the Army Materiel Command.

Dr. Yuko Shibata, a biochemist and recent Ph. D. recipient at Tokyo University, arrived in November as the first member of the group. He will work on the study of naturally occurring inhibitors of the cotton- and wood-destroying enzyme cellulase, under the supervision of Dr. Elwyn T. Reese, head of the microbiology laboratory, Pioneering Research Division.

Dr. John E. Giutronich, radiation physicist and lecturer at the University of New South Wales, Australia, will work at the Solar Furnace, the largest in the Western Hemisphere, in obtaining high temperatures, and their application to the study of the properties of materials.

Dr. John M. Davies, head of the radiation physics laboratory, will direct the study of the Solar Furnace, a scientific instrument which concentrates solar radiation into an image four inches in diameter, reaching temperatures as high as 5,000° F.

Dr. Dietrich Lang, an organic chemist from the University of Munich, Germany, will work with Dr. Torsten Hasselstrom, head of the organic chemistry laboratory, on the synthesis of sulfur-containing compounds for biodegradable detergents.

Dr. John W. Westwood, carbohydrate chemist, University of Birmingham, England, will be supervised by Dr. Louis Long, assistant head, organic chemistry laboratory, while working on synthesis of polyfunctional monomers of sucrose.

State Department authorization, under the Mutual Educational and Cultural Exchange Act of 1961, noted Natick's sponsorship of the visitors as contributing "to promote the better understanding of the United States among the peoples of the world, and to strengthen cooperative international relations."

Picatinny Arsenal improves combustible cartridge case.

Joint research effort results in a new nerve graft technique.

NATO countries metallurgists to gather at AGARD conference in Norway.

Picatinny Arsenal tests munitions with cobalt-60.

BioLabs Technical Information Center lauded for progress.

Watertown Arsenal seeks materials to meet mobility requirements.

R&D leaders pay tribute to HumRRO at dedication of new building.

Watervliet impact fatigue testing reduces weapons development time lag.

JUNE–JULY— *Army selects 20 winners at NSF-I for summer jobs or visits to laboratories.*

Realignment of Army Scientific Advisory Panel reduces membership to 25.

Army Chemical Information Data System is incorporated in the Army STINFO Program.

Rare heart operation at WRAIR pays off for Army wife's gamble for life.

R&D leaders consider system development and increased capabilities of Army in-house laboratories.

USAELRDL hosts world's largest power sources meeting.

NATO Special Working Group on Electrical Power Sources sets standardization goal.

Fort Detrick dedicates Biomathematics Center and new solid-state computing system.

Engineer R&D Laboratories, Fort Belvoir, nominate 11 for 1963 Techonological Achievement and Leadership awards.

Secretary of Defense Robert S. McNamara tells DIAC hope of more profits hinges on improved efficiency.

Army calls for bids on ultramodern night vision research facility.

DoD Directive 5500.7 prescribes standards of conduct for DoD personnel.

Discoveries spur nitroso rubber development.

Redstone Arsenal tries Automatic Drop Shipment of new books for scientists.

The Joint Congressional Committee on Atomic Energy reviews Army food irradiation progress at Natick.

AMC effects changes in industrial information program.

Watertown Arsenal develops rules for successful titanium joint welding.

Frankford Arsenal develops mobile microwave calibration facility.

Watertown Arsenal develops uranium alloys for weaponry material needs.

Army Medical Equipment R&D Laboratory at Fort Totten develops new field equipment.

USAERDL fuels decontamination program.

Defense officials observe Army R&D activities in Panama.

AUGUST— Plans for Civilian Career Program for Scientists and Engineers nearing completion.

Generals Ely, Engler, Clark involved in chain reaction shift.

Creativity Conflict: Management versus Scientists.

Army Chemical Information Data System progresses; contract awarded on the Army Chemical Typewriter.

Ballistics research expert named Deputy ASA (R&D).

Army Research Office initiates state-of-the-ground tropical research contract.

Army Chief Psychologist reports on human factors survey in Australia and New Guinea.

Army adds powerful single sideband air transportable radio terminal to Defense communications.

Defense Language Institute consolidates Armed Forces language programs.

Findings drawn for Eighth ABC Operations Research parley.

Army Munitions Command reorganizes.

WSMR contracts for new Nuclear Effects Laboratory.

Engineer R&D Laboratories test world's largest hasty storage tank.

215 leaders take part in Army problem solving experiment.

SEPTEMBER— *Lt Gen William Dick appointed Chief of Research and Development.*

Army prepares pilot program geared to DoD goals of Career System for Staffing Project Management Offices.

Brig Gen Lotz appointed Director of Army Research.

QM R&E Field Evaluation Agency's role.

Willis M. Hawkins appointed as ASA (R&D).

STINFO leaders planning for R&D Engineering Data and Information System.

WRAIR to host Ninth U.S. Army Human Factors R&D Conference.

Army colonel and nurse help to give new eyes to Portuguese girl.

Army Materials Advisory Group reports advances, sets up working groups.

Army Materiel Command reports first-year operation cost slash of $252 million.

Husband and wife contributing to research progress at Natick Labs on deterioration of Army supplies.

Israeli colonel discusses desert mobility problems related to one-year study at ATAC Locomotion Laboratory.

Electronics R&D Laboratory "supermarkets" aid supply needs.

Picatinny Arsenal Safety Design Criteria Program stirring interest.

Frankford Arsenal applies PAD knowledge to flight problems.

Contributions of food science to military needs to be discussed at Natick parley.

OCTOBER— Army heart pump raises development team hopes in comparative testing.

Electronics R&D Laboratory 5-man team gains honors at SA Awards ceremony.

Army awards two contracts for STINFO assistance.

Army Materiel Command long-range R&D planning.

USAPRO briefs Chief of Research and Development on human factors research.

Fourth Status Report on Fuel Cells indicates industrial interest.

ELRDL names 1963 Technical Achievement and Leadership Award winners.

BRL conducts 5-inch gun probes to 220,000 feet at Wallops Island Station.

Natick Laboratory honors Danish physicist for food radiation research.

U.S. Army Mobility Command-Engineer R&D Laboratories at Fort Belvoir.

Army Coating and Chemical Laboratory research serves Army materiel preservation.

Picatinny Arsenal obtains Federal Communications Commission approval for r-f research radio station.

Defense Documentation Center displays resources at the dedication of its new building.

Miniature launcher tests Little John drive.

Army Missile Command pushes program of graduate education.

Optic field suffering from decline of research and teaching.

Advanced fueling systems evaluated by QMREC.

Mobility engineers improve sea water distillation methods.

Industry leaders attend briefing on Army CIDS program.

NOVEMBER— *CRREL open house at new headquarters marks full-scale operation goal.*

Defense Supply Agency gains operational control of the Defense Documentation Center.

Theme of the Month: Science of Mobility.

Federal Council for Science and Technology airs scientific personnel management problems.

Congressional Record statement stresses STINFO Program need.

Growing need for human factors research stressed at parley.

Army, Navy and Air Force sponsors three science students in Japan Science Fair.

Civil Servant of the Year award accents women in science.

USAPRO blends research into information effort.

Army's first moon contact radar memorialized at USAELRDL.

Secretary Vance highlights ASAP meet by exchange on R&D.

AMEDS develops field medical treatment facilities termed the Medical Unit Self-Contained Transportable.

AFFCI move to Natick broadens food research and packaging program.

Army engineer shares honors with five winners of 1963 Rockefeller Public Service Awards.

Army contract orders 125 Larc XVs for U.S. and West Germany.

Record missile contract on Nike X swells the total of R&D and procurement expenditures to $390 million.

CDEC uses realistic model to plan operations in 100,000-acre battlefield.

Foreign scientists view human factors research.

"U.S. Army Blueprints for the Future" R&D van slated for tour of U.S.

Lt Gen Beach Wishes Newsmagazine Continued Success

My congratulations on the third anniversary of the *Army R&D Newsmagazine* must include my best wishes for its continued success as a media for disseminating news and knowledge which helps to tie together the Army's research and development community.

A review of history reveals that rarely have military doctrine and concepts kept pace with the weapons made available by the march of technology. The rifled musket of the Civil War, many times more lethal and effective than the smoothbore it replaced, led to tens of thousands of casualties on both sides, primarily because neither the North nor the South was able to formulate tactics and organizations which were markedly different from those of the Napoleonic era 50 years earlier.

The introduction of the machinegun in World War I led to a war of position in France where significant offensive action was impossible. The tank, if properly employed and exploited, could have perhaps broken the stalemated Western Front, but this weapon was never utilized to its fullest capabilities. History is replete with similar examples.

To insure that the U.S. Army takes full advantage of the military products of our advanced technology by the formulation of appropriate doctrine and concepts to exploit these products—to insure that the U.S. Army, today and tomorrow, is ready for any mission it may be called upon to perform—the U.S. Army Combat Developments Command has the job of planning for the future while being completely aware of the realities of the present.

The concepts, plans and requirements necessary to give the Nation a highly flexible, alert, responsive Army must come from a clear understanding of where we are now, plus a realistic estimate as to where we ought to be at various points in the years ahead.

Lt Gen Dwight E. Beach, Commanding General
U.S. Army Combat Developments Command

DDRE Visits Canal Zone RDT&E Sites

Defense Director of Research and Engineering Dr. Harold Brown returned early in January from a 2-week trip to the Canal Zone during which he inspected Army RDT&E facilities and met with top leaders.

Col Robert T. Larson, commander of the Army R&D Office in Panama, gave Dr. Brown a briefing on current operations and the overall mission. Other staff members explained specific phases of the tropical RDT&E program.

Facilities inspected by Dr. Brown included Army R&D Office test grids and jungle installations on the Atlantic side, the Gun Hill Meteorological Station, and the Air Force Tropical Survival School in the tropical forest on the Pacific side of the isthmus.

The marine atmospheric exposure site on the breakwater at Toro Point was visited to examine several hundred specimens of metals and protective coatings exposed to salt-laden atmosphere and intense solar radiation.

Dr. Brown also made a foray with Army R&D Office scientists into a deep jungle test site which gave him an opportunity to judge, firsthand, the merits of the Army jungle uniform, boots and other equipment. He also sampled boa and monkey meat and palm fronds as survival foods.

The DDRE's schedule included official visits to Maj Gen Robert J. Fleming, Jr., Governor of the Canal Zone; General Andrew P. O'Meara, Commander-in-Chief, United States Southern Command; and Maj Gen Theodore F. Bogart, CG of the United States Army Forces Southern Command. Briefings included work being done by the 8th Special Forces and Air Commandos.

12,000 Material Samples Used In Canal Zone Exposure Tests

Nearly 12,000 samples of various metals, elastomers, plastics, packaging materials, paints and lubricants have recently been placed at sites in the Canal Zone. Objective: To test their abilities to withstand the destructive characteristics of the tropical environment.

Frankford Arsenal in Philadelphia, Pa., and the U.S. Army Research and Development Office in Panama are conducting the tests to obtain information under conditions that range from open seacoast to deep jungle.

Numerous atmospheric measurements are being made at each site to determine the elements that are contributos to materiel degradation.

Although exposure tests have been conducted in the Canal Zone for a long time, this test is the largest and most closely controlled ever attempted by the Army.

Dr. Leonard Teitell, who has used Canal Zone as a laboratory some 20 years, is in charge of the project for Frankford Arsenal.

DDRE Dr. Harold Brown (second from right) inspects deterioration of protective coated specimens at jungle exposure site. U.S. Army R&D Office, Panama personnel are (l. to r.) Francis T. Brennan, engineer; Dr. Let T. Alpert, chief scientist; Col Robert T. Larson, commanding officer.

DDRE Cites Information Role of R&D Newsmagazine

One of the most informative and worthwhile Government publications that comes to my attention each month is the *Army Research and Development Newsmagazine*. If its title were to be accepted as an indication that contents are devoted exclusively to Army R&D activities, it might be regarded as a mild misnomer, since the publication deals with many Department of Defense activities interrelated with Army scientific interests.

Personnel in the Office of the Director Defense Research and Engineering have learned to look forward to each issue of the *Army R&D Newsmagazine* as an effective means of obtaining a broad view of what is happening throughout the Army scientific community. The publication is interesting, authentic, well edited and faithfully committed to its stated objectives.

The theme selected for the third anniversary edition of the Newsmagazine, that of the by-product benefits of Army research and development to the civilian population, highlights something we in the Defense establishment should never forget. While the goal of all military research and development is that of forging the power of the Nation to be equal to any emergency, new knowledge uncovered by that effort has, for many years, contributed significantly to a better way of life for civilians in time of peace, and will continue to do so in the future.

It is right and proper that the secondary results of military research and development should prove of great value to the civilian community, the taxpayers who pay the rising costs of that effort. As a peace-loving Nation, we stand committed to the use of the end products of military research and development only where necessary to preserve freedom for all those who cherish it. In terms of what they can do for the population who are not scientists or engineers, science and technology should be directed to improved living standards for all. By helping to preserve peace and freedom, military research and development contribute to an environment where that is possible. In advancing research and technology by spillover, they contribute as well.

The Office of the Director of Technical Information is an important new agency of the Office of the Director of Defense Research and Engineering, and is linked closely to the intensive effort of the Department of the Army in recent months to achieve important advances in the collection and dissemination of scientific and technical information.

The *Army R&D Newsmagazine* has performed, in a most creditable manner, a valued and appreciated service in reporting on newsworthy events pertaining to the Office of Defense Research and Engineering as they are related to Army R&D interests and responsibilities. I want to take this opportunity to express my thanks and to extend wishes for continued success in this important endeavor.

Harold Brown
Director of Defense Research and Engineering